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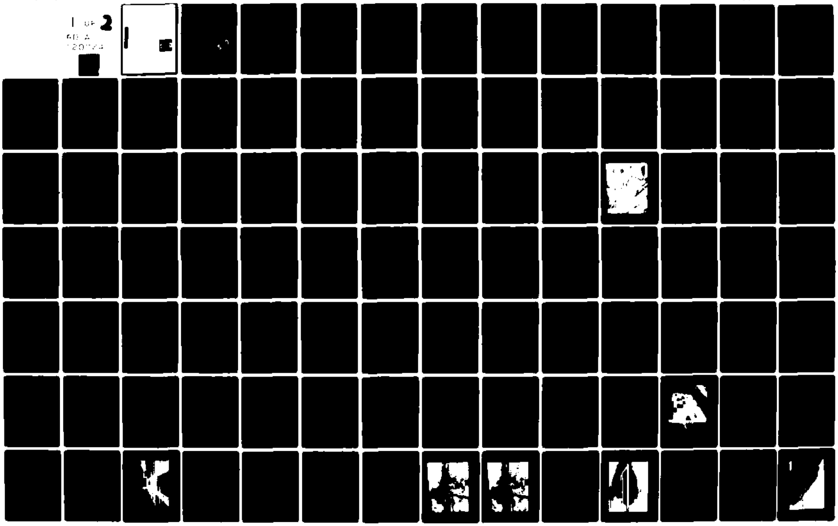

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The overall objective was to generate navigation and industrial forecasts; to identify physical, institutional, and regulatory constraints to barge traffic and related economic development; to translate these constraints into needs and analyze their impact; and to recommend actions that will alleviate the constraints and fill the needs.

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Using information from inventories and commodity forecasts, a constraint analysis and impact assessment and evaluation was performed on the following variables: channel capacity, bridges, locks, fleeting, terminals, other navigation considerations, and regulatory and legal matters.

Maps showing docks, fleeting areas, flood plain boundaries, recommended development sites, and land use were produced. These maps are on file at the St. Louis District, Corps of Engineers.

Kearney

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St. Louis District Corps of Engineers
210 Tucker Boulevard North
St. Louis, Missouri 63101

June 28, 1982

REFERENCE: Contract No. DACW43-81-C-0053

Dear Mr. Clark:

Kearney is pleased to submit the copies of its Final Report entitled "Navigation and Industrial Forecasts, Needs Analysis, and Recommendations For The Great River Resource Management Study - GREAT III".

We are pleased to have been of service to the Commercial Transportation and Industrial and Economic Development Work Groups in this important project. If Kearney can be of additional service to the Corps of Engineers, we will be responsive to your additional needs or requirements.

Respectfully submitted,

A. T. Kearney, Inc.

ST. LOUIS DISTRICT
CORPS OF ENGINEERS

FINAL REPORT

UNDER CONTRACT NO. DACW 43-81-C-0053

NAVIGATION AND INDUSTRIAL FORECASTS, NEEDS ANALYSIS AND RECOMMENDATIONS FOR THE GREAT RIVER RESOURCE MANAGEMENT STUDY

GREAT III

JUNE, 1982

PREPARED BY

Kearney: Management Consultants

IN ASSOCIATION WITH

Sverdrup & Parcel and Associates, Inc.

ST. LOUIS DISTRICT CORPS OF ENGINEERS

EXECUTIVE SUMMARY

NAVIGATION AND INDUSTRIAL FORECASTS, NEEDS ANALYSIS, AND RECOMMENDATIONS FOR THE GREAT RIVER RESOURCE MANAGEMENT STUDY

GREAT III

JUNE, 1982

Submitted by

A. T. KEARNEY, INC.

INTRODUCTION

This study is a joint effort of the Commercial Transportation and the Industrial and Economic Development Work Groups for which A. T. Kearney was contracted by the St. Louis District Corps of Engineers to provide analytical support. It is the third and final phase of the Great River Resource Management Study - GREAT III. The overall objective of this study was to generate navigation and industrial forecasts; to identify physical, institutional, and regulatory constraints to barge traffic and related economic development; to translate these constraints into needs and analyze their impact; and to recommend actions that will alleviate the constraints and fill the needs. Accordingly, this report has six primary objectives in order to accomplish the overall goal:

1. To generate and present resource inventories (i.e., terminal facilities, fleeting areas and available land inventories).

2. To develop forecasts of the magnitude and nature of barge traffic in the GREAT III reach.

3. To identify physical, institutional, and regulatory barriers that do and will constrain projected barge traffic and economic development.

4. To identify and evaluate suitable locations that have the best potential for river-related economic development.

5. To evaluate the impacts associated with constraints.

6. To identify and recommend measures that address and may alleviate the identified needs.

A statement of the findings with respect to each of the tasks associated with these objectives is provided below. The flow of the project was such that the inventories and forecasts were conducted concurrently. These two tasks then fed directly into the constraint analysis which in turn fed into the impact assessment. The categorization of land drew upon the inventory of available land. The constraint analysis, impact assessment and categorization of available land provided input for conclusions and recommendations.

INVENTORIES

GREAT III study area resource inventories were generated for terminal facilities, fleeting areas, and available land for river-related economic development.

(a) Terminal Facilities Inventory

The terminal facilities inventory was conducted in two steps. First, published secondary sources were used to identify and classify terminal facilities and to generate preliminary capacity estimates. Then, a telephone interview survey was conducted with companies operating terminals to generate final practical capacity estimates. The inventory identified 109 operating terminals which were then classified according to commodity groupings utilized in the commodity flow forecasts.

(b) Fleeting Areas Inventory

The purpose of the fleeting inventory was to identify existing fleeting locations within the GREAT III study area; to identify the number of barge storage spaces at each location; and to obtain data on fleeting operations. A two step approach to the inventory was taken. First, published secondary sources were referenced. Then, telephone interviews were conducted with fleeters regarding their operations. The fleeting inventory identified 51 fleeting locations containing 3,140 "for-hire" barge spaces in the study area. These fleets are operated by twelve public fleeters.

(c) Land Use Inventory

The purpose of the land use inventory was to identify and to evaluate those vacant lands adjacent to the Mississippi River for potential river-related industrial development. Both secondary and in-house sources were used to develop the inventory. A total of 136 locations were initially identified which were later evaluated and ranked according to suitableness for new terminal development.

FORECASTS

As part of the overall analysis of needs and constraints for GREAT III, it was necessary to develop forecasts under alternative scenarios of future commercial use of the Mississippi River. Ultimately, a total of nine unconstrained scenarios were developed.

An unmodified baseline scenario was generated by using data developed for the UMRBC Master Plan study. Unmodified high use and low use scenarios were generated by applying NWS growth rates to the baseline scenario. The other scenarios represented variations from these three. Potential reductions in future traffic resulting from rail mergers or increased user charges were examined in these other scenarios.

The forecasts are shown in the table below:

Forecast Results

Millions of Tons by the Year 2000

	Base-line	High Use	Low Use
Unmodified	158	162	150
Rail Merger	147	151	140
User Charge	146	146	138

These forecasts are for all classes of traffic; shipments, receipts, local, and through traffic.

As indicated, forecasted traffic levels are lower under the rail merger and user charge scenarios. The largest number for projected traffic in the year 2000 occurs under the unmodified high use scenario (162 million tons), while the lowest projected figure occurs under the user charge-low use scenario (138 million tons).

It was also found that seven commodities - grain, coal, chemicals, petroleum products, nonmetallic minerals, cement and stone, and iron and steel products - account for over 90 percent of study area traffic.

CONSTRAINT ANALYSIS

The following factors were identified and evaluated as potential constraints to barge traffic and economic development:

1. Channel capacity.

2. Bridges.

3. Locks.

4. Fleeting.

5. Terminals.

6. Other navigational constraints.

7. Regulatory and/or legal constraints.

Each was accorded separate treatment. Significant findings are presented below.

(a) Channel Capacity

Channel capacity was estimated at 480 million tons per year based on present average conditions. A theoretical maximum based on all tows having 25 barges would be 1,064 million tons. Since total traffic forecasted for the year 2000 according to the baseline scenario is 158 million tons, channels will clearly not constrain capacity in the future.

Safety problems associated with channels do exist, however. Safety hazards arise due to narrow stretches or bends, sunken barges, shallow areas, fleets or docks protruding into the channel, and channel markings, among others. No chronic or serious problems were identified.

(b) Bridges

Bridges spanning the Mississippi River can obstruct traffic and represent safety hazards as well. Of 17 bridges spanning the main channel, 7 bridges were identified as problem bridges. Causal factors for the problems include:

1. Lights.

2. Drafts (currents).

3. Upstream bend.

4. Restrictive clearances.

Safety is considered a serious problem at four of these eight bridges because high accident rates are associated with them.

(c) Lock Capacity

Locks exist at four sites in the study area. These represent potential capacity constraints because lock chambers restrict tow size, and more importantly, locks significantly increase transit time. Shortfalls in capacity are projected by the year 2000 for Lock and Dam 25 and Locks and Dam 26. Locks and Dam 26 will be a major constraint while Lock and Dam 25 will be a secondary constraint.

(d) Fleeting

Fleeting areas are potential constraints to both shipments and receipts of goods and to through traffic which is reconfigured. Although fleeting does not represent a constraint for the GREAT III reach as a whole fleeting problems are likely to develop between Locks 27 and mile 136. A shortfall of 554 barge spaces is possible within this sub-reach by the year 2000. Shortfalls within this sub-reach will not divert traffic, but rather will impose additional operating costs on users.

(e) Terminal Capacity

Inadequate terminal capacity for handling projected traffic flows was found to be a possible constraint with respect to grain, coal, chemicals, and iron and steel products. Under two different criteria for estimating new terminal requirements, additional capacity was found to be required by the year 1990. The greatest needs in the year 2000 are for new grain and chemical facilities. The largest number of new facilities required, 12, occurs under the high use (60 percent criterion) scenario. New terminal requirements for 1990 are significantly less than those for 2000. Similarly, new terminal requirements are moderately lower under the user charge and rail merger scenarios.

The maximum acreage required for the new terminals occurs under the high use scenario - 780 acres. This does not include acreage for associated manufacturing facilities. Like new terminal requirements, the user charge and rail merger scenarios moderately reduce the acreage requirements.

(f) Regulations

Certain regulations, (especially those involved in the Corps permit process), regulatory agencies and groups, and other laws present constraints to river related economic development in the

GREAT III study area. Regulations and problems were identified by interviewing and studying eight representative river-related development projects. The most problematical or potentially problematical regulations include:

1. Section 404 of the Clean Water Act.
2. Section 401 of the Clean Water Act.
3. Section 10 of the River and Harbor Act of 1899.
4. Endangered Species Act.
5. National Environmental Policy Act.
6. Floodplain Regulations.
7. Air Quality Act.
8. Illinois' Fleeting Permit Requirements.
9. Illinois' Rivers, Lakes and Streams Act of 1911.
10. Various Zoning Laws.

These regulations impede but do not preclude development. They can cause significant delays and added costs thereby constraining or even discouraging river-related industrial development. It was found in the case studies that private interests can achieve greater success with a project by more careful preparation and management of the project throughout the cumbersome permit process to its completion.

(g) Other Navigational Constraints

Other navigational constraints were cited by master pilots. These constraints include:

1. Channel dimensions.
2. Sunken barges/towboats.
3. Navigational aids maintenance.
4. Narrow stretches/bends.
5. Sailboats and pleasure craft.
6. Winter navigation.

Most of these constraints occur between St. Louis and Cairo, Illinois.

IMPACT ANALYSIS AND EVALUATION

The impacts of failure to mitigate or eliminate the problems identified in the constraint analysis were evaluated with respect to certain evaluation measures. The principal constraints and the associated evaluation measures are as follows:

1. Channels - Risks associated with unsafe conditions.

2. Bridges - Risks associated with bridges.

3. Locks - Tonnage not handled; risks associated with congestion.

4. Fleeting - Incremental transportation cost.

5. Terminals - Tonnage not handled; direct and indirect employment; investment impact.

6. Regulations - Months of delay; additional compliance costs and inflationary costs.

(a) Channels and Bridges

The chief impact of failure to address constraints involving channels and bridges is the exacerbation of the existing safety hazards. In general, an increasing number of accidents is likely due to channel obstructions and problem bridges.

(b) Locks

Locks also represent a safety hazard. An increase in traffic will likely increase the number of rammings. The inability of locks to accommodate barge traffic will result in diverted tonnage as high as 10.1 million tons by the year 2000.

(c) Fleeting

The impact of fleet constraints was measured by the incremental operating costs imposed on users, i.e., by the probable increase in the cost of fleeting service. It was estimated that the additional cost to users would range from $3.3 million to

$19.7 million in the year 2000. Using a weighted average of the maximum and minimum estimates, the incremental cost impact is $9.8 million annually.

(d) Terminals

The impact of insufficient terminal capacity was estimated using three measures; tonnage not handled, employment, and investment increment. With respect to tonnage not handled, a maximum loss of 10.1 million tons could result in the year 2000. A maximum loss of 6,049 new jobs in year 2000 could also result. Finally, a maximum loss of $10.1 and $105.7 million in capital expenditures for 1990 and 2000, respectively, could result from failure to add new terminal capacity.

(e) Regulations

The impact of regulations affecting river-related industrial development were measured by the length of delay and additional costs incurred. It was found that delays ranged from 4 to 22 months for the case-study developments. Higher development costs arising from the compliance activities and delays ranged from $100,000 to $650,000.

CATEGORIZATION OF LAND

Using the land use inventory which revealed the locations of tracts of land available for river-related industrial development, the locations were ranked by a scheme of criteria to determine those locations most compatible for industrial development. The ranking scheme identified 34 locations out of 136 as having the best potential. The remaining 102 locations were also listed. In addition, on-site and off-site order-of-magnitude costs for improving these tracts (for development) were generated since most locations identified needed improvements. Overall, a sufficient amount of land is available to meet the estimated need for new terminals for 2000.

Interviews were conducted with port authorities and other local development associations and organizations to review anticipated industry growth and provisions to accommodate the growth. Basically, the interviews supported the results of the categorization of land by finding:

1. An adequate amount of land is available, but in most cases, will require major improvements.

2. Industrial organizations are interested in locating in the GREAT III area, particularly, grain, coal, and chemical firms.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions ensuing from this study are as follows:

- Data base discrepancies in waterborne commerce data and the status and location of terminals make analysis and management of the navigation system difficult.

- Channels in the GREAT III study area are not expected to constrain traffic growth. Some safety hazards do exist, however. Improvement in channel markings and more channel markers are needed in some locations.

- Bridges in the GREAT III study area create safety problems for barge traffic but will not constrain traffic in the foreseeable future. The physical setting of some bridges contribute to problems at their locations, and narrow horizontal clearances, particularly at movable bridges, impose one-way traffic restrictions.

- Locks and Dam 26 will continue to constrain traffic growth in the future. Lock and Dam 25 will also constrain traffic of waterborne commerce late in the study period. However, the latter lock constraint will be effective only if additional capacity is added at both Locks and Dam 26 and Locks and Dam 27.

- Terminal capacity expansion will be required by 1990 and thereafter for four major commodity groups - grain, coal, chemicals, and iron and steel products. Higher user charges and/or rail mergers will probably reduce this need somewhat.

- Although fleeting is not a problem system-wide, it will be a problem in the sub-reach from Locks 27 to mile 136. Whether additional capacity is provided by increasing utilization of existing facilities or by adding capacity below mile 136, the cost to private users is expected to increase.

- Regulations generate confusion, delay, and added expense. Private interests that initiated their applications early in the development process and maintained continuous liaison with the various public agencies fared better in completing their projects on schedule. The sheer number and uncertainty of individual requirements is a major source of confusion. Some overlapping and redundant regulatory requirements were found.

o Sufficient land is available in the GREAT III reach for terminal and other river-related industrial development. Thirty-four prime locations were identified.

Recommendations arising from this study are as follows:

o The Corps should be provided adequate funding and should be required to update and maintain an accurate file of all permits and terminal facilities including fleeting areas.

o Congress should strive to provide adequate funding for maintenance of channels, including dredging, river training works, maintenance of channel markers and buoys, and removal of sunken barges.

o Movable bridges should be left open for the free passage of tows unless the frequency of train traffic exceeds the frequency of barges and other vessels. The Coast Guard should immediately review the operation of the Louisiana Railroad Bridge in this regard.

o Congress should adopt the recommendation of the UMRBC for a second chamber at Locks and Dam 26 and provide for the completion of all construction on a timely basis in order to accomodate projected traffic.

o Local port authorities and development agencies should continue to develop programs to promote port expansion, including the funding of necessary infrastructure improvements for preferred industrial sites, and to ensure the timely identification and resolution of other problems impeding growth. Federal agencies should seek closer consultation with local authorities to ensure that valid federal concerns are dealt with early in the development process.

o Local agencies should develop an inventory of potential fleeting sites in areas where capacity shortfalls are expected, and take steps to ensure their availability. These steps could range from zoning to obtaining options, to outright acquisition. The cooperation of federal agencies should be sought in resolving regulatory problems for these sites in advance of needs.

o Better informational packets cataloguing all laws and rules affecting development in the GREAT III area should be provided by local development agenices. Unnecessary or redundant federal, state, and local laws should be rescinded through legislative or administrative means. Regulatory bodies should ensure the dissemination of timely and accurate information about requirements and procedures for obtaining permits. Moreover, federal, state and local authorities should be explicit about the criteria used in applying their laws and be consistent in their administration.

o The Corps in conjunction with the Coast Guard should develop a multi-agency safety program and/or institute a safety task force charged with addressing the safety hazards within the GREAT III reach.

o Local development agencies should identify potential locations and ensure their availability by pursuing development of infrastructure improvements for the preferred sites. Sites with major problems should not be considered areas for potential development.

ST. LOUIS DISTRICT CORPS OF ENGINEERS

FINAL REPORT

NAVIGATION AND INDUSTRIAL FORECASTS, NEEDS ANALYSIS, AND RECOMMENDATIONS FOR THE GREAT RIVER RESOURCE MANAGEMENT STUDY

GREAT III

JUNE, 1982

Submitted by
A. T. KEARNEY, INC.

St. Louis District Corps of Engineers

Navigation and Industrial Forecasts, Needs Analysis, and Recommendations for GREAT III

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I - INTRODUCTION

This report is divided into eight chapters as follows:

- Introduction
- Inventories
- Barge Traffic Forecasts
- Sample River-Related Developments
- Constraint Analysis
- Categorization of Available Land
- Impact Assessment and Evaluation
- Conclusions and Recommendations

The purpose of this introductory chapter is to provide background information and an understanding as to how each of the above analyses feeds into one another in order to accomplish the overall study objective. Accordingly, each task will be discussed in turn to indicate how the particular analysis relates to the others. Before this discussion commences, however, the overall background, objective, and scope of the study is discussed. A final chapter presents the study conclusions and recommendations.

BACKGROUND

Commercial navigation on the Upper Mississippi River extends from above Minneapolis and St. Paul to the mouth of the Ohio River. However, the Upper Mississippi has not always been a navigable river over its entire length. The portion of the Upper Mississippi system covered by this study includes two parts of the river developed and maintained for navigation in distinctly different ways. Both portions are maintained by means of revetments, channel contraction dikes, and dredging. The river portion above mile 190.3 is a slackwater system since minimum water depths are maintained by a series of dams. These two navigation systems are described in more detail below.

In 1824, Congress authorized the Corps of Engineers to remove obstructions including snags, sandbars, and wrecks from the Mississippi. In the 1830s, passages through several rapids were made by dynamiting and excavating rock. Meandering sloughs and backwaters were closed off to confine flows to the main channel.

In 1878, Congress authorized the first comprehensive project for improving the Upper Mississippi River above mile 195.3 by authorizing the Corps of Engineers to establish and maintain a depth of 4.5 feet between the Twin Cities and the mouth of the Missouri. Navigation was improved by this project as a result of the construction of short canals through several rapids. In 1907, Congress authorized a six-foot channel. Navigation was improved with the construction of hundreds of wingdams.

In 1930, Congress authorized the construction of a nine-foot channel from the Twin Cities to the mouth of the Ohio River. This project was completed in 1940 and was by far the most ambitious of the river improvement projects. In addition to cutting rock, constucting wingdams, and dredging, the Corps of Engineers constructed a series of locks and dams to provide a series of lakes, referred to as pools, which provide the authorized depth for navigation during low flow. A total of 29 dams and locks were constructed. The lowest of these was Locks and Dam 26 at mile 202.9 completed in 1938. The Corps of Engineers was also authorized to maintain minimum river channel widths of 300 feet.

The slack water system was extended downstream in 1963 by the completion of the Chain-of-Rocks Dam, bypass canal, and locks. These locks are located at mile 185.1.

Since the completion of the nine-foot channel project, the Corps of Engineers has engaged in a variety of maintenance activities including dredging. The Mississippi River is a quick-shoaling river in continuous change despite the fact that most of the dams have been in place for 40 years. As a result of this continuous change, it has been necessary for the Corps to dredge at numerous locations to maintain an adequate depth and width for safe and efficient navigation.

In response to a lawsuit initiated by the Wisconsin Department of Natural Resources, the North Central Division of the Corps of Engineers (NCD) and the North Central Regional Director of the U.S. Fish and Wildlife Service established a partnership to try to work out a long-range management strategy for the development and maintenance of the Mississippi in an environmentally sound manner. These efforts have been combined into the Great River Environmental Action Team (GREAT). From 1974 to 1976, most of the GREAT activities focused on the Minnesota and Wisconsin portions of the Upper Mississippi River.

In 1976, Congress formally authorized the Corps of Engineers to investigate and develop, in cooperation with interested state and federal agencies, a river system management plan for the entire Upper Mississippi River. The authorizing legislation was under Section 117 of the Water Resources Development Act of 1976. To accomplish the objectives set by Congress, three study teams, GREAT I, II, and III, were established. The GREAT I study team developed recommendations for the portion of the river from the head of navigation in Minneapolis to Guttenburg, Iowa. The GREAT II study team developed recommendations for the portion of the river from Lock and Dam 10 at Guttenburg to Lock and Dam 22 at Saverton, Missouri. The GREAT III study team was responsible for the segment of the river from Saverton to the mouth of the Ohio River.

GREAT III ORGANIZATION AND OBJECTIVES

The GREAT III study team is divided into twelve work groups. This particular study was undertaken as a joint effort of the Commercial Transportation and Industrial and Economic Development Work Groups. The planning objectives of these two work groups, as described in the GREAT III Reconnaissance Report, are listed below.

The objectives of the Commercial Transportation Work Group are:

1. Insure sufficient width and depth to provide for the safe and efficient passage of nine foot draft vessels.

2. Seek means of improving economic efficiency and service.

3. Insure the availability of suitable areas for the development of terminals and fleeting areas to meet the present and future needs of water transportation.

4. Encourage the development of multi-modal transportation facilities.

5. Identify and evaluate the effects of commercial transportation activities for their social, economic and environmental beneficial or adverse impacts.

6. Seek a system for determining the proportionate allocation of public costs for river projects.

7. Minimize government controls to those economically justified or absolutely necessary to insure safe vessel operation and cargo transfer.

8. To objectively inform the public of the role, characteristics and requirements of the water transportaion system and how it is integrated into a total transportation network.

9. Identify restraints to commercial navigation that appear unjustified as to net public benefits.

10. Identify safety hazards to commercial navigation.

11. Determine future market demands and their effect upon barge traffic.

12. To minimize the physical constraints to navigation caused by locks, bridges, and other impediments.

The objectives of the Industrial and Economic Development Work Group are:

1. Develop a system for establishing regulations which balance the economic, environmental and cultural impacts of river-related commerce and economic development.

2. Improve and expand public awareness and understanding of waterbourne commerce and related economic activities, especially in regard to the area's standard of living.

3. Reduce and/or simplify the institutional and regulatory constraints and costs which presently discourage development, and be able to predict adverse effects (such as loss of jobs) on a particular area if and when an area is vacated by industry due to strict regulatory guidelines.

4. Encourage the development of multi-modal transportation facilities.

5. Provide a rational way for industry to develop and flourish in coordination with the low-cost transportation afforded by the river system.

6. Facilitate continued expansion of river-oriented commerce and economic development in order to promote growth in employment and personal income in the study area.

7. Ensure availability of an adequate supply of industrial land and supporting infrastructure for future development needs.

The firm of A. T. Kearney was contracted with to provide analytical support to the objectives of these two work groups.

OBJECTIVES

The overall goal of this study was to identify physical, institutional, and regulatory constraints to barge traffic and related economic development; to translate these constraints into needs; and to recommend actions that will alleviate the constraints and fill the needs. Accordingly, this report has six primary objectives in order to accomplish this goal:

1. To generate and present resource inventories (i.e. terminal facilities, fleeting areas, and available land inventories).

2. To develop forecasts of the magnitude and nature of barge traffic in the GREAT III area.

3. To identify physical, institutional, and regulatory barriers that do and will constrain projected barge traffic and economic development.

4. To identify and evaluate suitable locations for river-related economic development.

5. To evaluate the impacts associated with constraints.

6. To identify and recommend measures that address and alleviate the identified needs.

A separate chapter is devoted to each of these objectives and contains a more specific statement of the objective or purpose of the respective task.

SCOPE

The scope of the study involves two elements:

1. Geography
2. Time

The Upper Mississippi River above and including Lock and Dam 22 was addressed in prior GREAT studies. Cairo is at the junction of the Ohio and Mississippi. This junction defines the Upper Mississippi and the Lower Mississippi.

The geographic scope of the study includes the Mississippi River and adjacent counties and SMSAs between Saverton, Missouri and Cairo, Illinois. This corresponds to approximately a 300 mile stretch of the Mississippi River, beginning just below Lock and Dam 22 (river mile 301) and ending at Cairo (river mile 0).

The time horizon for analysis is from 1977 to 2000. Other requirements (e.g. additional terminal capacity) arising from projected traffic levels are provided for years 1990 and 2000.

APPROACH

The approach adopted for the study involved the following major tasks:

- Inventories of terminal capacity, fleeting capacity, and available riverfront land
- Barge traffic forecasts for the years 1990 and 2000.
- Constraint identification and analysis
- Impact assessment of failure to address constraints
- Categorization of land available for terminals and other river-related industrial development
- Conclusions and recommendations regarding possible solutions

Each of these tasks are dependent upon the output of one or more of the others for necessary input. The pattern of dependence is presented in the discussion of these major tasks which follows. Each task is briefly described here and treated in greater detail in separate chapters.

(a) Inventories

The first task consisted of generating inventories to support analyses of terminal capacity, fleeting capacity, and potential lands for river-related industrial development. The inventories of terminals and fleeting areas were generated through telephone interviews. The land inventory was generated through in-house data and published secondary sources.

The inventories provide input to the constraint analysis and categorization of available land. The terminal capacity and fleeting capacity inventories are used in conjunction with the barge traffic forecasts (described below) to identify potential constraints to barge traffic in the future. The inventories, as their name implies, are listings of all river terminal facilities, fleeting areas, and industrial developable riverfront land, respectively. For the terminal facilities and fleeting areas inventories, estimates of capacity were generated.

(b) Barge Traffic
Forecasts: 1977-1990-2000

At the same time as the inventories were being generated, unconstrained barge traffic forecasts depicting possible future commercial use of the Mississippi River were developed. The data base for the forecasts was an origin-destination matrix obtained through the Corps of Engineers generated for the Master Plan effort of the Upper Mississippi River Basin Commission (UMRBC). National Waterway Study (NWS) growth rates were then applied to this data to derive alternative high use and low use scenarios. A rail merger and user charge scenario were also developed. Ultimately, nine distinct scenarios were generated as indicated by the following illustration:

Figure I.
Diagram of Traffic Forecast Scenarios

Baseline		High Use		Low Use	
Rail Merger	User Charge	Rail Merger	User Charge	Rail Merger	User Charge

The forecasts represent essential input for the identification and analysis of potential constraints to barge traffic in the future. Forecasted traffic levels for the various commodities are used in conjunction with the terminal and fleeting capacity inventories to identify possible constraints. Once constraints are identified and terminal and fleeting requirements estimated, the land use inventory comes into play. Terminal and fleeting needs are related to the land use inventory to estimate whether sufficient land at convenient locations is available to alleviate these needs.

(c) Constraint Identification
and Analysis

Constraint identification and analysis constitutes the first major analytical task. Information gathered with respect to the inventories, particularly the terminal facilities and fleeting areas inventories, are used together with the forecasts of barge traffic for the GREAT III reach to identify potential constraints. Constraints so identified and evaluated included the following areas:

- Channel capacity
- Lock capacity
- Bridges
- Fleeting
- Terminal capacity

1. Channel Capacity. Channel capacity was estimated in a systematic fashion (see Chapter V-Channel Capacity). Because it is treated in depth in a later chapter, it will suffice to say here that channel capacity was considered a function of the number of tows annually, the number of loaded barges per ton, and the lading per barge. Having estimated the annual channel capacity, the estimate obtained was related to the traffic forecasts.

2. Lock Capacity. Locks represent potential constraints, because more time is required for tows to transit locks than any other component of the navigation system. Lock capacity was analyzed at the four locks and dams within the GREAT III reach by comparing the forecasted tonnages with the lock capacity as forecasted in the NWS and in the UMRBC master plan.

3. Bridges. Bridges, similarly, represent a constraint by obstructing the flow of traffic thereby adding to transit time. There are twenty bridges spanning the Mississippi within the study area which were analyzed. To identify problem bridges, two sources of information were used, master pilot interviews and NWS analysis.

4. Fleeting. Fleeting areas are used for the temporary storage of loaded or empty barges. Typically, river terminals can handle only a few barges at a time. As a result, when a tow drops off 10 or 15 barges at one time for a particular terminal, the terminal operator will hire a fleeting operator to place one or two of these barges at his dock and store the remainder until needed. Inadequate fleeting space may restrict the growth of traffic in the GREAT III study reach.

In analyzing fleeting as a constraint, the inventory of all "public" fleeters (those holding themselves out to the public for hire) within the study reach was utilized. This inventory, accomplished through phone interviews and Corps of Engineers data, provided a mapping of the fleet locations and established fleeting capacity on a pool by pool basis. The inventory covered the number of barge spaces available, annual throughput, the number of through barges handled by each fleeter and/or location, and other operational data.

5. Terminal capacity. The demand for additional terminal shipping or receiving capacity is a function of the tonnage projected to be handled at ports compared to available terminal capacity throughout the GREAT III reach. The projections supplied information on forecasted increases in originations, terminations, and through traffic for 14 commodity groups. The analysis concentrated on 7 commodity groups - grain, coal, petroleum products, chemicals, nonmetallic minerals, cement and stone, iron and steel products - which constitute over 90 percent of the total barge traffic for the study area. An inventory of "theoretical" terminal capacity was generated for all commodity groups. In addition, telephone interviews were conducted covering the aforementioned seven dominant commodity groups to establish a more pragmatic effective capacity figure. Information gathered from the interviews was also used in determining the additional terminal requirements which in turn were used to determine acreage requirements.

6. Other Navigational constraints. Other navigational constraints besides bridges and lock and channel capacity that in some manner affect the movement of traffic were identified during the course of interviews with master pilots. Master pilots interviewed had an average of 30 years of river piloting experience. Constraints identified include navigational aids, narrow areas/bends, pleasure craft, and winter navigation.

7. Regulatory constraints to industrial development. Problems associated with industrial development of the river were documented by conducting interviews with 8 sample industrial projects and reviewing other secondary sources. The progress of each development was traced with emphasis placed on identifying all regulations that impeded that progress.

(d) Impact Assessment of Failure to Address Constraints

An attempt was made to estimate the impacts and costs associated with failure to alleviate potential constraints identified. Evaluation measures used to estimate these impacts and costs include:

- Tonnage not handled
- Direct and indirect employment
- Tax base increments
- Incremental cost
- Safety (e.g., the risk of casualties, spills, damages, etc.)

Impacts arising from each constraint area were evaluated using one or more of these evaluation measures. (They will be discussed in more detail in Chapter VII which presents the impact assessment). This analysis drew upon the output of the inventories, barge traffic forecasting, and constraint analysis.

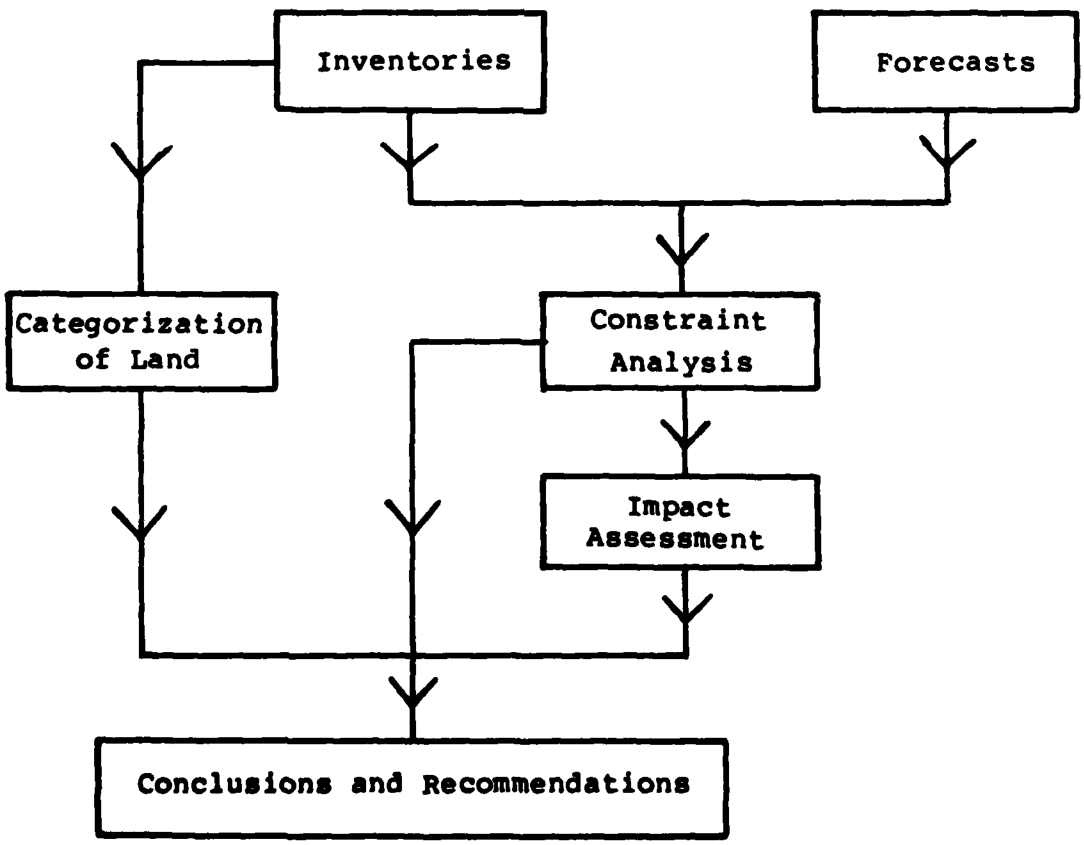
(e) Conclusions and Recommendations

This chapter serves to summarize and present specific conclusions from the completion of the tasks and subtasks discussed in this chapter. In addition, recommendations are advanced concerning possible solutions to alleviate the constraints identified during the course of the study.

Hence, each of the principal tasks provides input for one or more of the other tasks. The flow of the analysis is indicated by Figure I-2.

Figure I-2

GREAT III Study Flow Chart



II - INVENTORIES

Before undertaking the tasks of developing barge traffic forecasts and identifying and analyzing constraints to this traffic, inventories of terminal facilities, fleeting areas, and developable land were conducted. This section of the report is devoted to the discussion of these inventories. Each will be accorded separate treatment.

TERMINAL FACILITIES INVENTORY

The ultimate purpose of the inventory of terminal facilities was to provide a basis for the constraint analysis. This involved two major steps. The first step was to identify and classify existing facilities and develop preliminary capacity information. The second major step was to conduct followup detailed telephone interviews to generate additional information to support subsequent analysis. These two steps are described below.

(a) Identification of Facilities

Four principle sources were used to identify and classify terminal facilities. These were a list of existing Corps permits, a printout of the MARAD inventory generated as part of the Mid-America Ports Study (MAPS), a Corps printout of reported waterborne commerce originations and terminations by river mile, and the Inland River Guide, the principle commercial directory of river facilities.

The starting point was the Corps list of existing permits. This list was simply a list of permits currently in effect. This was compared to the MARAD listing which showed 9 additional terminals which were not on the Corps list, for a total of 190 facilities to be checked. Of these 62 were identified as recreation facilities, fleeting areas, and other activities not related to commercial terminals. This left 128 facilities or permits to be checked. Through a process of cross checking sufficient information was developed to postively identify 109 terminal facilities, leaving 19 facilities totally unexplained. None of these 19 reported any traffic in 1978 and do not appear in the Inland River Guide. Therefore they were considered to be inactive and not included in the final count.

The existing 109 terminals were classified to correspond to the commodity groupings utilized in the commodity flow forecasts.

The Tri-City *Regional* Port District located on the Chain of Rocks Canal in Granite City, Illinois is a prime example of modern port development in the GREAT III region.

These groupings are described more fully in Section III of this report. The classification of terminals is summarized in Table II-1 below.

Table II-1

Commercial Terminals in GREAT III Study Area

Commodity Groups		
Number	Name	Number of Facilities
I	Grains	35
II	Coal	28
III	Petoleum Products	27
IV	Chemicals and Fertilizer	44
V	Nonmetallic Minerals	26
VI	Cement and Stone	12
VII	Iron and Steel Products	25
VIII	Metallic Ores	5
IX	Crude Petroleum	8
X	Food Products	21
XI	Lumber and Wood Products	2
XII	Pulp and Paper	1
XIII	Waste and Scrap	8
XIV	Other Commodities	3
Subtotal		245
Eliminate double counting		(136)
Total Terminals		1[illegible]

In preparing this tabulation, a terminal was included in a commodity group if it handled a movement within that group in 1978, according to the detailed statistics provided by the Corps. Many of these terminals handle more than one commodity. This is particularly true of "for hire" public facilities which perform terminal and warehousing services without taking title to the goods themselves.

As part of this phase of the inventory, various published data were also reviewed for capacity information. Foremost among these were the Mid-America Ports Study. The approach to capacity estimating used in that study was to identify specific units of handling equipment and treat the manufacturer's rated capacity as a valid estimate of terminal capacity. Since this generated unrealistically high capacity estimates, an alternative approach was developed relying on information obtained from the terminal operators themselves. The methodology is described in Section V. The data gathering to support this methodology became the second major step of the terminal inventory and is described below.

(b) Telephone Interview Survey

Phone interviews were conducted with companies operating terminals on the Mississippi River within the GREAT III study reach. The purpose of these interviews was to generate information to support more practical measures of terminal handling capacities for the various commodity groups. That is, the interviews were designed to estimate the effective handling capacity of terminals rather than theoretical or design capacity, recognizing normal constraints. For purposes of the GREAT III analysis effective capacity is defined as the throughput that can be realized by a facility given normal operating constraints. Effective capacity is less than theoretical capacity.

The interview list was developed by incorporating the lists of companies contacted by Roger Kester and Associates for a different MARAD Terminal Facilities Inventory, and by Espey, Huston and Associates for their St. Louis Harbor Feasibility Study with other sources.

The phone interview priorities were based on maximizing coverage of major commodities as determined by projected tonnage figures. A breakdown of the number of interviews completed and contacts made by commodity is provided in Table II-2 below:

Table II-2

Terminal Interviews

Industry	Interviews	Contacts
Grain	8	12
Coal	8	8
Petroleum Products	12	18
Chemicals	8	13
Nonmetallic Minerals	6	6
Cement and Stone	4	4
Iron and Steel	6	6
Other	4	4
Total	56*	71

* Interviews are classified by primary business of interviewee.

A total of 56 interviews were completed covering 59 terminals while 71 companies/terminals were actually contacted. Interviews were considered "unsuccessful" and not classified as "completed" when the interviewee decline to provide input, the dock was not in use, or the terminal was in a transition phase, i.e., either closing or just starting up and the interviewee could not provide any relevant data.

FLEETING AREAS

An inventory of fleeting areas was also conducted. The purposes of the inventory were to identify all fleeting locations within the study area; to identify the number of barge storage spaces at each location; and to obtain data on fleeting operations. This inventory is later used in evaluating fleeting as a constraint.

The scope of the inventory was limited to those fleeters who provide for-hire services. A few fleeting areas which are dedicated for the private use of specific terminals, local holding areas for small numbers of barges associated with individual terminals, were not included in the inventory.

The inventory was generated from information supplied by the Corps of Engineers, the Inland River Guide, and telephone interviews. Fleeters were first identified and storage capacity figures generated by pool using secondary data sources. Then telephone interviews were conducted to develop more reliable figures with respect to fleeting locations, storage capacity, annual throughput, and other relevant information on operations, such as, length of stay of a barge in a fleet, and downtime due to flow conditions.

The results of the fleeting inventory are displayed in Table II-3. As indicated in the table, 3,140 "for hire" barge spaces were identified in the study area. This figure can be adjusted for downtime due to low (or high) water conditions which limit the effective storage capacity of a fleeting location. However, only three "public" fleeters indicated any problems in this regard affecting a total of 940 slots, all of which are below pool 27.

Table II-3

Fleeting Inventory by Pool or Subreach

Pool or Subreach	River Miles	Number of Barge Spaces	Number of Locations	Number of Fleeters Servicing
24	273-301	-	-	-
25	241-273	-	-	-
26	202-241	250	3	2
27	184-202	680	9	4
St. Louis	163-184	1,765	34	5
St. Louis to Cairo	0-163	445	5	4
Total		3,140	51	12*

* Some fleeters operate more than one location in more than one pool.

LAND USE INVENTORY

A land use inventory was also conducted. The purpose of this inventory was to identify and evaluate those vacant lands adjacent to the Mississippi River for potential river-related industrial development. This inventory was the initial task for ranking and subsequently identifying areas possibly suitable for new terminal development.

To identify potential development areas, past studies were first reviewed. These included:

- "Industrial Site and Building Survey" for Southwest Regional Port District by Southwestern Illinois Metropolitan and Regional Planning Commission (SIMAPC).

- "Industrial Port Site Survey" by SIMAPC.

- "Riverfront Industrial Development Potential for Locations along the Mississippi River: Lewis, Marion, Ralls, and Pike Counties, Missouri" by Mark Twain Regional Advisory Commission.

- "Study of the Port of Metropolitan St. Louis, Appendix I" by A. T. Kearney, Inc. and East-West Gateway Coordinating Council.

- "Opportunities for River-Related Industrial Development in the Port of Metropolitan St. Louis" for the First National Bank in St. Louis by Sverdrup Corporation.

Other locations were identified by using "Industrial Location Selection Criteria" (found in Exhibit VI-1) with color-coded land use maps developed in-house. All adjacent lands were mapped using a color coding scheme to mark their land use category.

Exhibit VI-2 and Exhibit VI-3 contain the inventory. The inventory revealed 136 locations which were later ranked according to certain location selection criteria to arrive at a final 34 suitable areas. The final categorization of suitable areas is treated in Chapter VI.

III - BARGE TRAFFIC FORECASTS

BACKGROUND

As part of the overall analysis of needs and constraints for Great III, it was necessary to develop forecasts of possible future commercial use of the navigation system within the study area. The scope of work called for consideration of a variety of potential alternative future scenarios. Ultimately, nine distinct scenarios were developed. These are described in this chapter. Once the scenarios are described and displayed, they are compared to constraints to determine future needs in subsequent chapters.

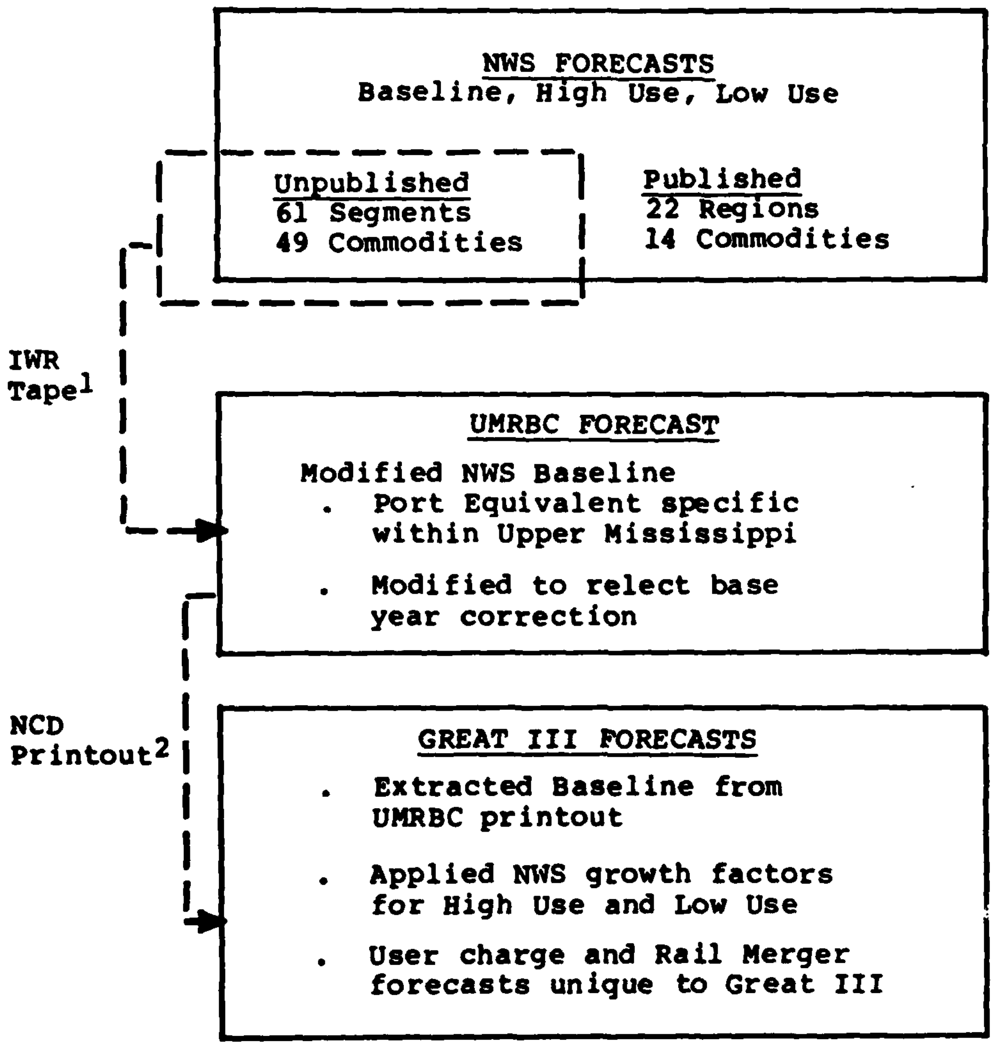
GENERAL FORECASTING METHODOLOGY

The forecasts are unconstrained forecasts of future commercial use of the navigation system. The forecasts do not take into account constraints to commerce since the ultimate objective is to identify and evaluate the impact of those constraints.

The basic approach in developing forecasts for use in the Great III Study was to rely as extensively as possible on existing forecasts, since so much work was going on simultaneously in conjunction with the National Waterways Study (NWS) and the Master Plan effort of the Upper Mississippi River Basin Commission (UMRBC). Consequently, forecast information was obtained through the Corps of Engineers pertaining to the Master Plan effort and utilized in the preparation of scenarios for this study. In order to properly understand the forecasts displayed in this report, it is necessary to describe in some detail how these forecasts were derived from the other ongoing studies.

The derivation of the Great III forecasts is displayed schematically in Figure III-1 on the following page.

FIGURE III-1
Relationship of GREAT III Forecasts to Other Forecasts



Notes: (1) IWR is the Institute for Water Resources. IWR managed the National Waterways Study (NWS).

(2) NCD is the North Central Division of the Corps of Engineers. NCD has responsibility for Corps participation in the UMRBC Master Plan Effort.

The largest single ongoing forecasting activity at the time that this study was in preparation was the set of activities associated with the National Waterways Study.[1] Since the Upper Mississippi River Basin Commission (UMRBC) also required forecasts of future commercial use during a time frame contemporaneous with the ongoing NWS analysis and the analysis of Great III, the UMRBC also was faced with a decision as to whether or not original forecasts should be prepared or whether existing forecasts should be relied upon. Finally, the officials responsible for the preparation of the Master Plan decided to utilize the NWS forecasts as much as possible. A computer tape of the NWS forecast was obtained from the Institute of Water Resources and utilized by the UMRBC Master Plan Navigation/Transportation Work Team (hereafter, Master Plan Study Team). This in turn generated a set of forecast information in the form of a large origin destination matrix for 14 commodity groupings which was provided for the purposes of this study.

Figure III-1 identifies three alternative scenarios prepared for the National Waterways Study. Specific forecasts shown in Figure III-1 were the baseline forecast, the high use scenario forecast, and the low use scenario forecast. These particular forecasts were developed to serve NWS needs and to evaluate the capability of the entire navigation system under conditions of normal expected use, increased use, and reduced use by commercial users. Forecasts were prepared at two different levels of aggregation in conjunction with the National Waterways Study. First of all, the nation was divided into 62 analysis segments and the commodity information was divided into 49 analysis commodities. Second, the more detailed forecasts were aggregated into 22 reporting regions and 14 reporting commodity groupings. The information provided by the Institute for Water Resources to the UMRBC included coverage of shipments and receipts at the analysis segment level.

The availability of this information in turn allowed other offices of the Corps of Engineers, working as part of the UMRBC team, to develop a forecast of future use designed specifically to serve the needs of the Master Plan effort. It is important to point out that the UMRBC ultimately used only the baseline scenario prepared originally for NWS. The result of this effort was an origin-destination matrix defined for 14 commodity groups, in which the origins and destinations on the Upper Mississippi River and Illinois waterway were specified at the individual pool (port equivalent) level, with the larger aggregations for the rest of the system beyond Cairo, Illinois.

Note: (1) A complete discussion of the original traffic forecasting methodologies, data, and assumptions used in the National Waterways Study can be found in two NWS documents. These are a report entitled Traffic Forecasting Methodology and Appendix A to a report entitled Evaluation of the Present Navigation System.

The commodity groupings used and the geographic breakdown of the study are summarized in Tables III-1 and III-2.

Table III-1

Forecast Commodity Groups

Group Name	Commodities Included
Grains	Corn, Wheat, Soybeans, Other Field Crops
Metallic Ores	Iron Ore, Non-Ferrous Ores, Ore Concentrates
Coal	All types of coal
Crude Petroleum	Crude Petroleum
Non-Metallic Minerals	Sand, gravel, crushed rock, phosphate rock, limestone, sulfur, other non-metallic minerals
Food Products	Soybean Meal, flour, other grain mill products, vegetable oils, other food products
Lumber and Wood Products	Logs, lumber, plywood, other lumber and wood products
Pulp, Paper and Allied Products	Pulp, paper, and other products
Chemicals	All organic and inorganic chemicals, all industrial and agricultural chemicals
Petroleum and Coal Products	Gasoline, jet fuel, kerosene, distillates, residuals, other products
Cement and Stone	Ferrous and non-ferrous shapes, sheets, plates, beams, pipe, and tube; and coke
Waste and Scrap	Metal scrap, other scrap and waste
Other Commodities	All Others

Table III-2

Origin-Destination Subdivisions of GREAT III Study Area

Subdivision	River Mile Points
Main Stem Mississippi Cairo to Locks 27 (Including St. Louis below Locks 27 and Sawyer's Bend area)	0 - 190.3
Pool 27 (excluding Missouri River)	190.3 - 203
Pool 26 (excluding Illinois River)	203 - 241.5
Pool 25	241.5 - 273.4
Pool 24	273.4 - 300

In the course of developing these commodity flow forecasts, the Master Plan Study Team discovered certain discrepancies in the two data bases maintained by the Corps of Engineers relating to waterborne commodity movements. These two data bases are the waterborne commerce statistics assembled and provided by the Waterborne Commerce Statistics Center in New Orleans, and the Performance Monitoring System data developed at individual locks and maintained at the Corps District level. Apparently, undercounting of waterborne commerce was discovered in the data base upon which the original NWS forecast was based. The Master Plan Study Team accordingly adjusted the original NWS forecast upward for some individual commodity groupings and for some particular origin-destination pairs. This influenced not only total shipments and receipts but routings through individual locks. The baseline origin destination matrix provided by the Master Plan Study Team was the basis for the Great III baseline scenario.

The high use and low use Great III scenarios were developed by applying growth factors derived from the original NWS forecast to the information provided by the UMRBC. The user charge and rail merger scenarios were in turn based upon analyses applied to the three Great III scenarios relating to baseline, high use, and low use conditions. The net result for Great III was a total of nine forecasts.

Thus, although there is a traceable flow of forecast information from one study to another, none of the forecasts are identical. These differences arise primarily from different study objectives, base year adjustments, and different geographic scopes of the studies. None of the forecasts are directly comparable to one another. Further it should be noted that the term "scenario" is used differently in the three studies discussed here. In NWS and Great III, scenarios are forecasts of future commercial use unconstrained by the navigation system. In the UMRBC Master Plan, there is only one unconstrained forecast and "scenarios" are actually forecasts of the interactions between different development alternatives and the single baseline forecast.

BASIC SCENARIO ASSUMPTIONS

The original NWS scenarios (prepared originally in 1979) relied upon a proprietary macroeconomic model of the economy of the United States of America developed by Data Resources, Inc. This model incorporates the ability to modify some of the most important basic assumptions about the forecast and the effects of those assumptions on the total economy and the resulting movements of waterborne goods. The development of the original NWS scenarios is described in detail in the NWS reports.

The fundamental assumptions about the United States underlying the original NWS baseline scenario include:

1. A fertility rate that approaches 2.1 children per woman (a level that is consistent with zero population growth).

2. A small reduction in the mortality rate for all age groups.

3. Economic recovery in 1981 from a 1980 recession.

4. Corporate and personal income tax cuts in 1981 of $20 billion.

5. A public sector that grows no faster than the rate of growth in GNP.

These original assumptions were specified in 1979, early in the development of the NWS scenarios.

Additionally, assumptions important to certain specific industries were also incorporated into the original NWS baseline analysis. For example, average corn yields per acre were projected to increase to 121 bushels by the year 2003. Also, exports of coal were projected to increase to 107 million tons by the year 2003 in the baseline case.

The high use and low use scenarios modified some of these assumptions. The principal difference in the high use scenario from the baseline was an assumed increase in the domestic consumption of coal. Also, coal exports were assumed to increase to 156 million tons by the year 2003. These are the only differences between baseline and high use that affect the Great III forecasts.

The low use scenario on the other hand developed for NWS resulted in lower levels of waterborne commerce across virtually all commodity groups and in virtually all regions. The major assumption under the low use scenario is an assumption that the Government sector increases its percentage of total economic activity from 32 percent in 1981 to 36 percent in the year 2003. This results in reduced private sector activity. Also, corn yields are projected to grow at a somewhat lower rate. Also, reduced activity in iron and steel on the Great Lakes results in increased iron and steel traffic on the rivers. These are not the only variations across these scenarios in the original NWS work. Rather they are the most important ones that affect the results as far as Great III is concerned.

GREAT III SCENARIOS

Five different scenario concepts were developed for Great III. Since two of the five represented variations from the other three, a total of nine distinct forecasts were developed. The actual forecasts of future commodity movements are contained in Exhibits III-1 through III-9 at the end of this chapter.

As discussed above, the first scenario to be developed for Great III was the *baseline scenario*. This was merely a tabulation of the relevant forecast values from the data developed for the UMRBC Master Plan effort. The high use and low use scenarios for Great III were in turn developed by applying adjustments derived from the original NWS forecast work.

The other two Great III scenarios involved examining the potential reductions in future traffic resulting from specific conditions in the future which could be different from those assumed in the underlying forecasts. The first of these involved an examination of the potential impact of railroad mergers. The trend towards railroad mergers was given impetus by the Staggers Act of 1980, which made the accomplishment of railroad mergers easier. One aspect of the current wave of railroad mergers in this industry is the creation of new railroads that cross traditional territorial boundaries in "end-to-end" mergers. This should enhance the ability of the railroad industry to compete effectively for long haul movements that might otherwise be susceptible to waterborne commerce.

Since much of the growth in commerce in the Great III study area is expected to be coal shipments, it was decided to focus upon the effects of these mergers on coal. This was also a logical focus because of the recent growth in the study area of shipments of western coal brought in by rail, primarily by the Burlington Northern Railroad, to be loaded onto barges for shipment to other destinations. Grain was also considered as a commodity for detailed analysis. However, the existence of substantial water competitive rail movements, both by single line movements and through existing joint rates, indicates that railroads are already able to compete effectively for this particular traffic. Thus, the potential impact of railroad mergers on coal would be the most likely to have a significant effect upon the growth of commerce in the Great III area.

The scenario was developed based upon a focus on particular railroads. Specifically, it was assumed that the Burlington Northern-Frisco merger and the Union Pacific-Missouri Pacific merger would be accomplished. Other proposed mergers between the Family Lines System and the Chessie Railroad, and between the Southern Railway System and the Norfolk and Western Railroad were also considered. However, these mergers were found not to be particularly important to coal shipments from this study area. Having identified the relevant railroad mergers, the available routings created by these new mergers were compared to the routings of waterborne coal movements. Based upon this comparison it was concluded that the destination regions of the Upper Lower Mississippi (Cairo to Baton Rouge), the Lower Mississippi (Baton Rouge to the Gulf), and the Gulf Coast East, would be the most highly affected. It was assumed for analytical purposes that 40 percent of future growth in coal shipments to these destinations would be diverted as a result of these mergers. The reduced coal shipments were incorporated into the baseline, high use, and low use scenarios in turn.

A second scenario involved consideration of user charges for the inland water way system. At the present time operators are required to pay a fuel tax which increases to 10 cents a gallon on October 1, 1985.

It is assumed for purposes of this analysis that a 35 cents per gallon fuel tax would be imposed which would result in recovery of 100 percent of operations and maintenance costs as presently recorded in the accounts of the Corps of Engineers. It is also assumed that the alternative modes (e.g., railroads) and routings (e.g., Great Lakes) would not adjust their prices upward in response to additional inland waterway user charges.

AGRICULTURAL TRAFFIC

The GREAT III Study area is defined as a part of the Mississippi River which either originates much of the domestic U.S. waterborne commerce related to agriculture or through which passes much of this traffic. This has been historically true and is expected to continue in the future. The growth of this activity will depend first of all upon continued growth in the production of agricultural commodities and second on continued growth in the foreign demand for American agricultural products. There are more reasons to expect these driving forces to continue than to expect them to slow down.

The two commodity groups of direct interest to agriculture in the study area are grains and food products. (Fertilizers are also of importance to agriculture, but they are included with all other chemicals in this study.) In the base year of 1977 these two commodity groups totaled 36.425 million tons and accounted for 43.3 percent of total study area traffic. Under the baseline scenario these two commodity groups are forecast to increase to 76.336 million tons by the year 2000 (or 48.2 percent).

The waterborne commerce in agricultural commodities is the same for the baseline and high use scenarios. Only under the low use is waterborne commerce expected to decline as a result of somewhat lower levels of overall production. The user charge scenario in turn would result in diversion of approximately 10 percent of most of these commodities to other modes.

COAL TRAFFIC

The transportation of coal by water has always been a substantial share of the study area's total waterborne traffic. The importance of coal has increased in recent years with initiation of rail to water transfers of western produced coal in the study area. This is a totally new movement and has changed the nature of waterborne coal transportation in the area. In the past coal originations and through shipments were predominantly upbound to coal consumers on the Upper Mississippi and Illinois Rivers.

While these movements remain important the trend is now for increased downbound movements to destinations beyond the study area limits.

In the 1977 base year, study area traffic in coal was 11.231 million tons or 13.4 percent of total study area traffic.

The production, consumption, and export of coal in the United States is expected to increase substantially in the future. It is not a question of whether or not these increases will occur, rather it is a matter of when the increases will occur and by how much. This increased production, consumption, and export of coal, will in turn result in the increased transportation of coal by all modes. Consequently, variations in the growth of future coal traffic will have the greatest impact upon growth in total waterborne traffic in the future. The underlying forecast of coal varies across the baseline, high use, and low use scenarios for the Great III Study area. The rail merger scenario explicitly assumes diversions of specific amounts of coal being shipped from the study area to specific destinations. Contrary to other studies, the user charge scenario found that no coal would be diverted to other modes of transportation as a result of the imposition of additional user charges.

Total study area coal traffic in the year 2000 is forecast to be 32.920 million tons under the baseline scenario, a 193 percent increase over the base year. The total coal traffic for GREAT III in the year 2000 ranges from a low of 22.0 million tons under the low use - rail merger (40 percent diversion) scenario to a high of 36.7 million tons under the high use scenario.

It is important to note that no coal shipments currently originate in the study area above Locks 27 although coal traffic moves through this and the other locks. The logic of locating coal terminals below the locks is compelling (e.g., avoidance of lock congestion and winter shutdowns of locks). This advantage for the part of the study area below Locks 27 is expected to continue unchanged in the future. Thus, the major growth in coal shipments downbound in the study area will be unaffected by conditions at the locks.

CHEMICAL TRAFFIC

Waterborne trade in chemicals has been historically important to the study area and this importance is expected to continue. The commodity grouping for GREAT III encompasses agricultural chemicals (primarily inbound fertilizers for distribution) and industrial chemicals (both inbound and outbound) centered in the St. Louis area. The production and consumption of chemicals in the United States generally has grown rapidly since World War II. While this growth may be slowed somewhat by federal programs to reduce dangers to the population and environment associated with the production, transporation, consumption, and waste disposal of these products, it is reasonable to expect overall activity to increase. There are no special assumptions in the GREAT III forecasts involving these commodities other than variations associated with overall economic activity and user charges. In the case of user charges, since railroads compete intensively for this traffic already, and virtually all chemical industry facilities capable of handling barges can also handle rail cars, the diversion factor applied is one of the highest of all the commodity groups, second only to that of iron and steel products.

Barge traffic in chemicals was 7.925 million tons for 1977 under the baseline scenario, or 9.4 percent of total GREAT III area traffic, and is projected to increase to 18.342 million tons by 2000 representing 11.6 percent of total traffic.

PETROLEUM TRAFFIC

Waterborne traffic of both petroleum and petroleum products occurs in the study area. Crude petroleum is brought in by barge to refineries in the St. Louis area. Products are shipped to a variety of destinations. Most shipments and through traffic are upbound and consist of fuel oils which are too viscuous for pipeline transportation.

Growth has been relatively stagnant in recent years. The GREAT III forecast of these commodities is for a stable traffic volume, neither increasing nor decreasing, as other energy sources are developed and per capita energy consumption continues to decline. Some diversion to pipelines may occur if additional waterway user charges are imposed, as pipeline operators strive to cover their high fixed costs in shrinking markets. However, no diversion of these commodities under additional user charges is assumed here because of the high percentage of products not susceptible to pipeline transportation.

IRON AND STEEL TRAFFIC

Traffic in iron and steel products is a relatively minor percentage of total study area traffic. Traffic consists of through movements and nearly balanced shipments and receipts. Shipments include some coke and non-ferrous products. Most shipments and receipts are focused in the St. Louis area. Shipments originate in local foundries and mills and receipts are ultimately destined mostly for regional service centers. This traffic moves through a variety of single purpose private terminals and multi-product public terminals. Future growth is expected to be influenced mostly by overall economic activity, with no special trends evident in the study area.

Iron and steel products accounted for 3.993 million tons, or 4.7 percent of total study area traffic in the base year of 1977 under the baseline scenario. This traffic is projected to increase to 5.742 million tons by the year 2000, representing 3.6 percent of total traffic according to baseline scenario. Under the user charge scenario, iron and steel products traffic ranges from 3.9 million tons under baseline to 5.0 million tons under low use in the year 2000.

ALL OTHER COMMODITIES

Other commodities are driven in the Great III forecast primarily by variations in the overall level of economic activity. That is, there are no differences between the high use and baseline scenarios for these commodities. Only under low use is overall traffic lower. These commodities accounted for 15.6 percent of total study area traffic in the base year of 1977. Total traffic in these commodities is expected to increase to 11.735 million tons by the year 2000 and account for 7.4 percent of total traffic at that time under the baseline scenario.

BARGE TRAFFIC FORECAST

BASELINE
(Thousands of Tons)

Commodity	1977 Shipments and Receipts	1977 Through Routings	1977 Total Traffic	1990 Shipments and Receipts	1990 Through Routings	1990 Total Traffic	2000 Shipments and Receipts	2000 Through Routings	2000 Total Traffic
All Commodities	35,753	48,253	84,006	54,201	66,739	120,940	67,780	90,618	158,398
Grain	6,355	28,826	35,181	10,834	42,198	53,032	15,169	59,386	74,555
Coal	9,565	1,666	11,231	21,804	3,281	25,085	28,845	4,075	32,920
Petroleum	8,950	4,403	13,353	8,601	3,998	12,599	8,666	3,984	12,650
Chemicals	1,763	6,162	7,925	2,871	9,646	12,517	4,339	14,003	18,342
Nonmetallic Minerals	1,637	1,967	3,604	1,209	1,509	2,718	1,067	1,709	2,776
Cement and Stone	2,465	306	2,771	3,145	156	3,301	4,406	497	3,903
Iron and Steel Products	1,874	2,119	3,993	2,368	2,611	4,979	2,747	2,995	5,742
Metallic Ores	75	39	114	93	54	147	104	62	166
Crude Petroleum	14	738	752	14	665	679	14	659	673
Food Products	183	1,061	1,244	218	1,297	1,515	247	1,534	1,781
Lumber	41	91	132	59	110	169	62	123	185
Pulp and Paper	6	50	56	6	62	68	6	73	79
Waste and Scrap	203	173	376	214	149	363	206	134	340
Other Commodities	2,622	652	3,274	2,765	1,003	3,768	2,902	1,384	4,286

EXHIBIT III-2

BARGE TRAFFIC FORECAST

LOW USE
(Thousands of Tons)

Commodity	1977 Shipments and Receipts	1977 Through Routings	1977 Total Traffic	1990 Shipments and Receipts	1990 Through Routings	1990 Total Traffic	2000 Shipments and Receipts	2000 Through Routings	2000 Total Traffic
All Commodities	35,753	48,253	84,006	53,983	65,171	119,154	65,371	84,133	149,504
Grain	6,355	28,826	35,181	10,738	40,721	51,459	14,529	53,329	67,858
Coal	9,565	1,666	11,231	22,108	3,281	25,389	27,726	4,075	31,801
Petroleum	8,950	4,403	13,353	8,337	3,878	12,215	8,236	3,900	12,136
Chemicals	1,763	6,162	7,925	2,839	9,569	12,408	4,190	13,821	18,011
Nonmetallic Minerals	1,637	1,967	3,604	1,174	1,539	2,713	1,061	1,709	2,770
Cement and Stone	2,465	306	2,771	2,934	149	3,083	3,161	477	3,638
Iron and Steel Products	1,874	2,119	3,993	2,496	2,783	5,279	2,972	3,306	6,278
Metallic Ores	75	39	114	90	53	143	99	59	158
Crude Petroleum	14	738	752	13	644	657	13	610	623
Food Products	183	1,061	1,244	212	1,231	1,443	210	1,132	1,342
Lumber	41	91	132	59	110	169	62	123	185
Pulp and Paper	6	50	56	6	62	68	7	71	78
Waste and Scrap	203	173	376	213	148	361	211	137	348
Other Commodities	2,622	652	3,274	2,764	1,003	3,767	2,894	1,384	4,278

EXHIBIT III-3

BARGE TRAFFIC FORECAST

HIGH USE
(Thousands of Tons)

Commodity	1977 Shipments and Receipts	1977 Through Routings	1977 Total Traffic	1990 Shipments and Receipts	1990 Through Routings	1990 Total Traffic	2000 Shipments and Receipts	2000 Through Routings	2000 Total Traffic
All Commodities	35,753	48,253	84,006	55,639	66,739	122,378	71,562	90,618	162,180
Grain	6,355	28,826	35,181	10,834	42,198	53,032	15,169	59,386	74,555
Coal	9,565	1,666	11,231	23,242	3,281	26,523	32,627	4,075	36,702
Petroleum	8,950	4,403	13,353	8,601	3,998	12,599	8,666	3,984	12,650
Chemicals	1,763	6,162	7,925	2,871	9,646	12,517	4,339	14,003	18,342
Nonmetallic Minerals	1,637	1,967	3,604	1,209	1,509	2,718	1,067	1,709	2,776
Cement and Stone	2,465	306	2,771	3,145	156	3,301	3,406	497	3,903
Iron and Steel Products	1,874	2,119	3,993	2,368	2,611	4,979	2,747	2,995	5,742
Metallic Ores	75	39	114	93	54	147	104	62	166
Crude Petroleum	14	738	752	14	665	679	14	659	673
Food Products	183	1,061	1,244	218	1,297	1,515	247	1,534	1,781
Lumber	41	91	132	59	110	169	62	123	185
Pulp and Paper	6	50	56	6	62	68	6	73	79
Waste and Scrap	203	173	376	214	149	363	206	134	340
Other Commodities	2,622	652	3,274	2,765	1,003	3,768	2,902	1,384	4,286

EXHIBIT III-4

BARGE TRAFFIC FORECAST

USER CHARGE*

BASELINE
(Thousands of Tons)

Commodity	1977 Shipments and Receipts	1977 Through Routings	1977 Total Traffic	1990 Shipments and Receipts	1990 Through Routings	1990 Total Traffic	2000 Shipments and Receipts	2000 Through Routings	2000 Total Traffic
All Commodities	35,753	48,253	84,006	51,471	60,147	111,618	64,305	81,504	145,809
Grain	6,355	28,826	35,181	9,751	37,978	47,729	13,652	53,447	67,099
Coal	9,565	1,666	11,231	21,804	3,281	25,085	28,845	4,075	32,920
Petroleum	8,950	4,403	13,353	8,601	3,998	12,599	8,666	3,984	12,650
Chemicals	1,763	6,162	7,925	2,469	8,296	10,765	3,732	12,043	15,775
Nonmetallic Minerals	1,637	1,967	3,604	1,088	1,358	2,446	960	1,538	2,498
Cement and Stone	2,465	306	2,771	2,831	140	2,971	3,065	447	3,512
Iron and Steel Products	1,874	2,119	3,993	1,894	2,089	3,983	2,198	2,396	4,594
Metallic Ores	75	39	114	84	49	133	94	56	150
Crude Petroleum	14	738	752	13	599	612	13	593	606
Food Products	183	1,061	1,244	196	1,167	1,363	222	1,381	1,603
Lumber	41	91	132	53	99	152	56	111	167
Pulp and Paper	6	50	56	5	56	61	5	66	71
Waste and Scrap	203	173	376	193	134	327	185	121	306
Other Commodities	2,622	652	3,274	2,489	903	3,392	2,612	1,246	3,858

* Assumes 100 percent recovery of operations and maintenance expense by means of fuel tax.

EXHIBIT III-5

BARGE TRAFFIC FORECAST

USER CHARGE*

LOW USE
(Thousands of Tons)

	1977			1990			2000		
Commodity	Shipments and Receipts	Through Routings	Total Traffic	Shipments and Receipts	Through Routings	Total Traffic	Shipments and Receipts	Through Routings	Total Traffic
All Commodities	35,753	48,253	84,006	51,268	58,709	109,977	61,966	75,634	137,600
Grain	6,355	28,826	35,181	9,664	36,649	46,313	13,076	47,996	61,072
Coal	9,565	1,666	11,231	22,108	3,281	25,389	27,726	4,075	31,801
Petroleum	8,950	4,403	13,353	8,337	3,878	12,215	8,236	3,900	12,136
Chemicals	1,763	6,162	7,925	2,442	8,229	10,671	3,603	11,886	15,489
Nonmetallic Minerals	1,637	1,967	3,604	1,057	1,385	2,442	955	1,538	2,493
Cement and Stone	2,465	306	2,771	2,641	134	2,775	2,845	429	3,274
Iron and Steel Products	1,874	2,119	3,993	1,997	2,226	4,223	2,378	2,645	5,023
Metallic Ores	75	39	114	81	48	129	89	53	142
Crude Petroleum	14	738	752	12	580	592	12	549	561
Food Products	183	1,061	1,244	191	1,108	1,299	189	1,019	1,208
Lumber	41	91	132	53	99	152	56	111	167
Pulp and Paper	6	50	56	5	56	61	6	64	70
Waste and Scrap	203	173	376	192	133	325	190	123	213
Other Commodities	2,622	652	3,274	2,488	903	3,391	2,605	1,246	3,851

* Assumes 100 percent recovery of operations and maintenance expense by means of a fuel tax.

EXHIBIT III-6

BARGE TRAFFIC FORECAST

USER CHARGE*

HIGH USE
(Thousands of Tons)

Commodity	1977 Shipments and Receipts	1977 Through Routings	1977 Total Traffic	1990 Shipments and Receipts	1990 Through Routings	1990 Total Traffic	2000 Shipments and Receipts	2000 Through Routings	2000 Total Traffic
All Commodities	35,753	48,253	84,006	51,471	60,147	111,618	64,305	81,504	145,809
Grain	6,355	28,826	35,181	9,751	37,978	47,729	13,652	53,447	67,099
Coal	9,565	1,666	11,231	21,804	3,281	25,085	28,845	4,075	32,920
Petroleum	8,950	4,403	13,353	8,601	3,998	12,599	8,666	3,984	12,650
Chemicals	1,763	6,162	7,925	2,469	8,296	10,765	3,732	12,043	15,775
Nonmetallic Minerals	1,637	1,967	3,604	1,088	1,358	2,446	960	1,538	2,498
Cement and Stone	2,465	306	2,771	2,831	140	2,971	3,065	447	3,512
Iron and Steel Products	1,874	2,119	3,993	1,894	2,089	3,983	2,198	2,396	4,594
Metallic Ores	75	39	114	84	49	133	94	56	150
Crude Petroleum	14	738	752	13	599	612	13	593	606
Food Products	183	1,061	1,244	19[illegible]	1,167	1,363	222	1,381	1,603
Lumber	41	91	132	53	99	152	56	111	167
Pulp and Paper	6	50	56	5	56	61	5	66	71
Waste and Scrap	203	173	376	193	134	327	185	121	306
Other Commodities	2,622	652	3,274	2,489	903	3,392	2,612	1,246	3,858

* Assumes 100 percent recovery of operations and maintenance expense by means of a fuel tax.

EXHIBIT III-7

BARGE TRAFFIC FORECAST

RAIL MERGER

BASELINE
(Thousands of Tons)

Commodity	1977 Shipments and Receipts	1977 Through Routings	1977 Total Traffic	1990 Shipments and Receipts	1990 Through Routings	1990 Total Traffic	2000 Shipments and Receipts	2000 Through Routings	2000 Total Traffic
All Commodities	35,753	48,253	84,006	46,611	65,427	112,038	57,666	88,988	146,654
Grain	6,355	28,826	35,181	10,834	42,198	53,032	15,169	59,386	74,555
Coal	9,565	1,666	11,231	14,214	1,969	16,183	18,731	2,445	21,176
Petroleum	8,950	4,403	13,353	8,601	3,998	12,599	8,666	3,984	12,650
Chemicals	1,763	6,162	7,925	2,871	9,646	12,517	4,339	14,003	18,342
Nonmetallic Minerals	1,637	1,967	3,604	1,209	1,509	2,718	1,067	1,709	2,776
Cement and Stone	2,465	306	2,771	3,145	156	3,301	3,406	497	3,903
Iron and Steel Products	1,874	2,119	3,993	2,368	2,611	4,979	2,747	2,995	5,742
Metallic Ores	75	39	114	93	54	147	104	62	166
Crude Petroleum	14	738	752	14	665	679	14	659	673
Food Products	183	1,061	1,244	218	1,297	1,515	247	1,534	1,781
Lumber	41	91	132	59	110	169	62	123	185
Pulp and Paper	6	50	56	6	62	68	6	73	79
Waste and Scrap	203	173	376	214	149	363	206	134	340
Other Commodities	2,622	652	3,274	2,765	1,003	3,768	2,902	1,384	4,286

EXHIBIT III-8

BARGE TRAFFIC FORECAST

RAIL MERGER

LOW USE
(Thousands of Tons)

Commodity	1977 Shipments and Receipts	1977 Through Routings	1977 Total Traffic	1990 Shipments and Receipts	1990 Through Routings	1990 Total Traffic	2000 Shipments and Receipts	2000 Through Routings	2000 Total Traffic
All Commodities	35,780	48,253	84,006	46,278	65,171	111,449	55,658	84,133	139,791
Grain	6,355	28,826	35,181	10,738	40,721	51,459	14,529	53,329	67,858
Coal	9,565	1,666	11,231	14,401	3,281	17,682	18,013	4,075	22,088
Petroleum	8,950	4,403	13,353	8,337	3,878	12,215	8,236	3,900	12,136
Chemicals	1,763	6,162	7,925	2,839	9,569	12,408	4,190	13,821	18,011
Nonmetallic Minerals	1,637	1,967	3,604	1,174	1,539	2,713	1,061	1,709	2,770
Cement and Stone	2,465	306	2,771	2,934	149	3,083	3,161	477	3,638
Iron and Steel Products	1,874	2,119	3,993	2,496	2,783	5,279	2,972	3,306	6,278
Metallic Ores	75	39	114	90	53	143	99	59	158
Crude Petroleum	14	738	752	13	644	657	13	610	623
Food Products	183	1,061	1,244	212	1,231	1,443	210	1,132	1,342
Lumber	41	91	132	59	110	169	62	123	185
Pulp and Paper	6	50	56	6	62	68	7	71	78
Waste and Scrap	203	173	376	213	148	361	211	137	348
Other Commodities	2,622	652	3,274	2,764	1,003	3,767	2,894	1,384	4,278

EXHIBIT III-9

BARGE TRAFFIC FORECAST

RAIL MERGER

HIGH USE
(Thousands of Tons)

Commodity	1977 Shipments and Receipts	1977 Through Routings	1977 Total Traffic	1990 Shipments and Receipts	1990 Through Routings	1990 Total Traffic	2000 Shipments and Receipts	2000 Through Routings	2000 Total Traffic
All Commodities	35,753	48,253	84,006	47,524	66,739	114,263	60,038	90,618	150,656
Grain	6,355	28,826	35,181	10,834	42,198	53,032	15,169	59,386	74,555
Coal	9,565	1,666	11,231	15,127	3,281	18,408	21,103	4,075	25,178
Petroleum	8,950	4,403	13,353	8,601	3,998	12,599	8,666	3,984	12,650
Chemicals	1,763	6,162	7,925	2,871	9,646	12,517	4,339	14,003	18,342
Nonmetallic Minerals	1,637	1,967	3,604	1,209	1,509	2,718	1,067	1,709	2,776
Cement and Stone	2,465	306	2,771	3,145	156	3,301	3,406	497	3,903
Iron and Steel Products	1,874	2,119	3,993	2,368	2,611	4,979	2,747	2,995	5,742
Metallic Ores	75	39	114	93	54	147	104	62	166
Crude Petroleum	14	738	752	14	665	679	14	610	673
Food Products	183	1,061	1,244	218	1,297	1,515	247	1,132	1,781
Lumber	41	91	132	59	110	169	62	123	185
Pulp and Paper	6	50	56	6	62	68	6	71	79
Waste and Scrap	203	173	376	214	149	363	206	137	340
Other Commodities	2,622	652	3,274	2,765	1,003	3,768	2,902	1,384	4,286

IV - SAMPLE RIVER-RELATED INDUSTRIAL AND ECONOMIC DEVELOPMENT

One objective of this study was to identify and then assess the impacts of existing or proposed government regulations and other related problems which in some way (e.g., caused inordinate delays) impede the progress of industrial development.

Rather than conduct an exhaustive review of laws and regulations an alternative methodology was used as specified in the scope of work. The approach taken was to rely on the actual experience of recent river related developments. Thus eight recent permits were selected and detailed interviews conducted with the applicants. Based on these actual experiences, various laws, regulations and problem areas were identified for further study and evaluation. This approach did not attempt to identify and tabulate every single law or regulation that might possibly affect river related development. Rather the emphasis was focused on problems identified as a result of actual experience, based on the perceptions of the developers.

CASE STUDIES OF RIVER RELATED DEVELOPMENT

(a) Selection of Sample Developments

The Industrial and Economic Development and Commercial Transportation Work Groups guided the selection of relevant developments suitable for study by providing a list of current developments and suggesting several key ones. A. T. Kearney acting on this counsel selected eight from the list. Table IV-1 shows the number and type of developments or activities contacted.

Table IV-1

Number and Type of Interviews Conducted

Number	Type
1	Fertilizer Facility
2	Coal Transfer Facilities
2	Port Authorities
1	Fleeting Operation
1	Pipeline Operation
1	Light Industrial/Residential Area
8	Total Number of Developments

(b) Method of Study

Telephone interviews were conducted with officials at the facilities of the types shown in Table IV-1. The interviews followed a format in which the interviewee was asked to describe the progress of the development from the planning stage to the present state or completion of the project. During the course of the interviews, if certain regulations, regulatory groups, and other potential problem areas were not mentioned, (e.g., certain archaeological/environmental laws and groups), the interviewee was specifically asked the impact of these. In addition, interviewees were asked to assess by ranking as either major or minor the extent to which a factor was perceived to be an obstacle to development.

(c) Results of Case Study Interviews

The results of the interviews are displayed as a problem matrix in Table IV-2. The eight sample developments have been masked to retain their confidentiality. As indicated in the table, the progress towards development of five of the projects was characterized as relatively smooth. The progress of two was characterized as difficult, and the progress of the remaining project could not be characterized since it was only in the preliminary planning stages. Although the overall progress of five projects was described as smooth, numerous obstacles which caused delays nevertheless were identified.

Certain activities were cited by the interviewees which promote relatively "smooth" progress. These activities include:

- Choose locations that don't require dredging.
- Discuss and outline with the Corps of Engineers project plans and in turn receive feedback as to who and what agencies to contact and what studies to conduct.
- Maintain an active dialogue with the Corps throughout the process.
- Monitor the progress of permits through the Corps' processes.

- Contact agencies and interested parties to explain development plans, and to become aware of their concerns so that these concerns can be addressed.
- Conduct preliminary studies to identify and resolve potential environmental problems.
- Utilize prior experience with facility location which enables anticipation of problem areas.
- Hold public discussions with local residents, businesses, and other interested parties.

Table IV-2

GREAT III Facility Development Problem Matrix

Regulation/Agency/Problem	Facilities Characterized by Relatively Smooth Development*					Facilities Characterized by Rough Development*		Other
	A	B	C	D	E	F	G	H
Regulations								
Section 404 Permit			Required		Required			
Section 401 Certification			Required		Required Major			
Section 10 Permit	Required	Required		Required		Required	Required	Required
Agencies								
Corps of Engineers								
- Delays in Processing/ Signing the Permit	Minor			Major		Major	Major	
- EIS Requirement				Major	Minor			
- Dredging					Major			
- Other Rulings/ Activities					Major			
Federal EPA		Major	Minor		Major			
U.S. Fish and Wildlife	Minor		Minor		Minor	Major	Major	
FEMA								Major
EDA					Major			
Illinois DOT Permit		Major						
Illinois Department o Conservation						Major		
Illinois EPA		Minor	Minor					
Missouri Clean Water Commission								
Missouri Department of Conservation					Minor			
Missouri Department of Natural Resources					Minor			
Other Private Interests								
Local Residents/Business	Minor	Minor		Minor	Minor	Major		
Historical/Archaeological Societies		Minor	Minor			Major		
Other Environmental Groups e.g., Sierra Club, Audubon Society	Minor					Major		
Other Problems								
Unavailable Sites						Major		Major
Renegotiation of Fixed Price Contract Due to Delays		Major						

* Overall assessment by respondent.

Note: Major and minor designations reflect the extent to which respondents perceived the factor to be an obstacle to development.

A common element to most of these activities is the practice of engaging in preliminary discussions with interested parties, especially the Corps of Engineers, in order to elicit their concerns. These can then be resolved before the project is well underway and before they cause substantial delays and additional costs.

Only one of the sample developments (on which a final decision is still pending) covered by the interviews was prohibited by the regulatory process. Virtually all of the interviewees reported that development had been delayed by the permit process and that no permit was approved within the time frame indicated by the public agencies involved. Some applicants had to change their plans or seek a different location. However, all except the one application still pending resulted in some development taking place.

The length of time required to complete the permit process was perceived by the interviewees as the major obstacle to development. Most problems are encountered during the public review period of the permit process. Delays in obtaining a permit are usually incurred in resolving objections voiced during public review. The most serious objections and consequently those causing the longest delays are raised by environmental agencies and groups, particularly the federal EPA and the U.S. Fish and Wildlife Service. Although the activities involved in obtaining a permit comprise the major obstacle to development, dissatisfaction with the permit process is directed towards the Corps. This indicates a lack of understanding of the permit process and of the Corps' role in that process on the part of business and industry concerns.

(d) Conclusions

To avoid serious problems and excessive delays, pre-application and pre-public review activities are important. Among these activities, holding preliminary discussions with the Corps and establishing lines of communication with government agencies, local residents, environmental groups, and other interested parties seem to hold the key for hastening the development process.

EVALUATION OF REGULATIONS

The evaluation process consisted of a classification of the laws and regulations identified in the case studies by Kearney into categories defined by the scope of work. These categories are (1) laws that are inefficient, inoperable, or serve no useful purpose, (2) laws that have an unbalanced approach, and (3) laws that are complex and administratively unmanageable. Laws and regulations were assigned to these categories based on a thorough review by the Kearney team of the interview findings and comments by case study respondents. The evaluation indicates those regulations or areas of the permit process that can frustrate applicants. Alternatively, the evaluation may indicate a lack of understanding by applicants of the activities involved in obtaining a permit and the roles of the federal and state agencies in that process. The evaluation matrix is shown in Table IV-3.

Table IV-3

Evaluation Matrix for Regulations Affecting Development

Laws and Regulations	Inefficient, Inoperable, or Serves No Useful Purpose	No Balanced Approach	Complex and Administratively Unmanageable
Federal Laws			
Section 404 of Clean Water Act	X	X	X
Section 401 of Clean Water Act	X		X
Section 10 of River and Harbor Act of 1899			
Endangered Species Act		X	
National Environmental Policy Act	X		
Flood Plain Regulations	X		X
Air Quality Act		X	X
Illinois Laws			
Fleeting Permits(1)	X		
Rivers, Lakes and Stream Act of 1911	X		
Local Laws			
Various Zoning Laws			X

Note: (1) The authority of the Illinois DOT to issue fleeting permits was repealed in 1981 while this study was underway. However, according to an Illinois DOT official, this does not remove the requirement to obtain state approval for fleeting.

(a) The Corps Permit Process

As indicated earlier, the permit process is perceived to be the major obstacle to development. The process itself is rather complex and time consuming. Objections raised, particularly by environmental groups, may unduly delay the permit process. A common perception is that environmental groups do not always voice legitimate objections, but do so solely to delay or discourage economic development.

Obtaining permits, in general, is perceived to be unduly complex, especially if dredging is required at the site. In that event, both a Section 404 permit of the Clean Water Act of 1977 and a Section 10 permit of the River and Harbor Act of 1899 are required. Section 404 regulates the discharge of dredged or fill material into the water. Section 10 regulates structures or work in or affecting navigable waters. The Section 404 permit program covers all waters while the Section 10 program covers only navigable waters.

Section 10 permits are relatively easy to obtain while Section 404 permits are rather difficult to obtain. One reason for this is that public notice is required by law for a Section 404 permit, whereas it is not required by law and may not be necessary under Section 10. Another factor complicating the obtaining of a Section 404 permit is that the selection and use of disposal sites for the dredged or fill material is done in accordance with guidelines (published in 40 CFR Part 230) developed by the Administrator of the EPA in conjunction with the Secretary of the Army. If these guidelines prohibit the selection or use of a disposal site, the Chief of Engineers may consider the economic impact on navigation of such a prohibition in reaching his decision. Furthermore, the Administrator can prohibit or restrict the use of any defined area as a disposal site whenever he determines, after notice and opportunity for public hearings and after consultation with the Secretary of Army, that the discharge of such materials into such areas will have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas, wildlife, or recreational areas.

Moreover, since 1976 Section 404 includes adjacent wetlands, defined as areas where a prevalence of the vegetation is adapted for life in saturated soil conditions. Environmentalists allegedly have used this designation to try and classify every area adjacent to the river as a wetland. When these claims arise, the Corps of Engineers is responsible for determining their validity (which can involve considerable time). Although the Section 404 program is complex, there are many exceptions to the Section 404 program and the applicant should discuss the project with the Corps before applying.

The formal procedures for obtaining either a Section 404 or Section 10 permit according to the Corps of Engineers' permitting branch are as follows:

1. Applicant sends a letter to the Corps with a set of (complete and accurate) preliminary plans for the proposed project.

2. Upon receipt, the Corps will advise the applicant whether a Section 404 permit is required. If so, the Corps will send both a Section 404 permit application and a Section 10 application.

3. Applicant sends application back to Corps.

4. The Corps then conducts a preliminary environmental assessment to determine whether a full EIS is required. The Corps rarely requires a full EIS.

5. The Corps goes out on public notice usually within 15 days after receipt of the application. Plans for the proposed project are mailed to all local, state, and federal agencies, special interest groups, mayors and post offices in the area, and people on the Corps mailing list for review. There is a 30 day review/comment period.

6. After the 30 day review period, the Corps takes any objections made and notifies the applicant of these. The Corps and the applicant try to resolve the differences with the objectors. The Corps actually acts as a mediator in this regard.

7. Once the objections are resolved, the Corps drafts the permit and sends it to the applicant who then signs it and returns it to the Corps for signing.

8. Corps signs permit.

If there are only minor objections, the permit usually will be issued within 60-90 days after receipt of the application. The Corps official noted that the St. Louis Corps averages around 80 days. At present, the St. Louis branch is well above average in processing permit applications, relative to other districts, despite having fewer personnel devoted to permitting, according to the same official.

(b) Other Laws and Permits

In addition to the Corps permit program, Section 401 of the Clean Water Act empowers each state with permit authority. Every Section 404 permit also requires state water quality certification. The state must grant a waiver or certify that the proposal will not hurt the water quality. Certification is required for any dredging, draglining, or fill operation in a waterway or a wetland associated with the particular state. The state certifying agencies are the Missouri Clean Water Commission and the Illinois Environmental Protection Agency.

In addition to any required federal permits, construction activities in or near Illinois rivers, lakes and streams require a permit from the State of Illinois. Permits are obtained from the Illinois Department of Transportation Division of Water Resources. If applicants do not apply for federal and state permits at the same time, the applicants incur unnecessary delay and expense,

Based upon the results of the case study survey, respondents view some elements of the federal and state permit process as unnecessary, adding to both the complexity of the permit process and the time involved in obtaining all required permits. For example, the Federal Section 401 water quality certification requirement and the State of Illinois permit requirement were cited by respondents as examples of duplicative requirements.

This perception may be based upon an incomplete or incorrect understanding of the reasons for and nature of the permit process and the need to protect both federal and state interest in navigation and other resources. The regulatory bodies involved also have a responsibility to disseminate timely and accurate information about requirements and procedures for obtaining permits.

The Illinois Department of Transportation, Division of Water Resources, the Illinois Environmental Protection Agency and the U.S. Army Corps of Engineers instituted a joint permit application in January, 1982. This should assist industry in applying for and obtaining all of the required permits.

Other federal and state laws require water and air quality permits and certifications. These laws also were cited by the various interviewees as impediments to development. However, it is important to note that the requirement for point discharge permits and air quality certification are not unique to river related development. These laws bind all industrial development wherever it occurs. Since the focus of this analysis is on those laws and regulations uniquely impacting river related development, the general requirements for these permits are not evaluated further. These laws are identified and described in Appendix A.

A number of other federal laws were cited by the interviewees as affecting their developments. While these laws cover all types of development, not just river related development, they come into play indirectly through the Section 10 permit process, even if no dredging is required.

The Corps is required to ensure that the applicant is in compliance with these laws before a permit is granted under any legal authority.

As already stated, environmental regulations and compliance activities cause the principal delays in the permit process. These regulations are perceived by industry to be weighted in favor of environmental interests and therefore may not adequately take into account economic benefits arising from projects.

One important law mentioned by two of the interviewees, is the Endangered Species Act of 1973 (16 USC 1531 et seq.). The purpose of this Act is to conserve threatened and endangered species and the ecosystems on which those species depend. The Act provides that federal agencies must utilize their authorities in furtherance of its purposes by carrying out programs for the conservation of endangered or threatened species, and by taking necessary actions to insure the continued existence of such species and their habitats.

The requirements of the Endangered Species Act are very strict. If there is any suspicion that a proposed development may adversely affect a designated species covered by the law, serious problems can result. First, delays and extra costs are incurred while a determination is made regarding the presence of the species in the area affected by the proposed development and, if found to be present, then the impact of the proposed development on the species must be determined. A finding of adverse impacts on protected species can result in denial of the permit, depending on the magnitude of the impacts and the total circumstances surrounding the case. While no interviewee indicated that a permit had been denied solely as a result of this law, two interviewees indicated that concerns had been voiced and additional time consumed while the law was exercised. It is important to note that no scientific or factual basis is required for the law to be brought into play.

Allegations concerning adverse consequences to protected species are sufficient for a formal determination to be required, imposing additional delays.

Another major federal law which can be triggered by the permit process is the National Environmental Policy Act (NEPA). This law requires that Environmental Impact Statements (EIS's) be prepared for all major federal actions. Since permits for large scale commercial developments are often construed as major federal actions, applicants for permits may be required to prepare full scale EIS's. These documents, by law, are subjected to public review. The minimum elapsed time allowed by regulation for completing the review process for an EIS is 9 months. Often much more time is required. Only one interviewee specifically mentioned this law for one major terminal the firm had built. No specific problem was associated with that particular EIS other than additional time and expense.

A major federal program cited by several interviewees is the National Flood Insurance Program. This program is administered by the Federal Emergency Management Administration (FEMA). Under the program, individual communities must adopt and enforce certain regulations regarding floodplain management to remain in the program. These regulations typically prohibit developments in floodways and stipulate that all new construction must be above the 100 year floodplain. The purpose of these laws is to reduce future flood damages by ensuring that developments in flood prone areas are either avoided or undertaken in a way that minimizes the risk of future damages occurring. Since virtually all river related commercial development occurs in floodplains, this regulatory requirement almost always comes into play.

The primary effects of the law are to preclude some sites from development or impose additional flood protection and/or flood proofing costs on developers. One interviewee was particularly concerned about the seemingly haphazard and arbitrary manner by which FEMA designated sites as flood hazard areas. This interviewee identified acreage that FEMA had previously approved for development which now was being subjected to reclassification.

Compliance with other Acts concerning preservation of historical or archaeological finds can be a major constraint although they only represented minor problems for the developments studied. The National Historic Preservation Act of 1966 (80 Stat. 915, 16 USC 470) created the Advisory Council on Historic Preservation to advise the President and Congress on matters involving historic preservation. In performing its function the Council is authorized to review and comment upon activities licensed by the Federal Government which will have an effect upon properties listed in the National Register of Historic Places, or eligible for listing.

The concern of Congress for the preservation of significant historical sites is also expressed in the Preservation of Historical and Archaeological Data Act of 1974 (16 USC 469 et seq.), which amends the Act of June 27, 1960. By this Act, whenever a Federal construction project of federally licensed project, activity or program alters any terrain such that significant historical or archaeological data is threatened, the Secretary of the Interior may take action necessary to recover and preserve the data prior to the commencement of the project. (33 CRF Part 305).

Two of the interviewees also mentioned local zoning laws as barriers to development. In one case, zoning precluded development. In another case, land was acquired for development and the zoning bodies announced that they planned to change the zoning. The concern here is the apparent arbitrariness of some zoning decisions by some local governments. This was not identified as a widespread problem throughout the GREAT III area.

Although none of the case studies involved facilities regulated by the Coast Guard, the impact of regulations associated with oil transfer facilities and safety regulations associated with waterfront facilities that handle dangerous cargo can be significant. The Coast Guard has indirect responsibility over the siting of new facilities by way of operational safety regulations and enforcement. The authority of the Coast Guard is derived from the Port and Tanker Safety Act of 1978. The Act required the Coast Guard to "take into account all relevant factors concerning navigation and vessel safety and the protection of the marine environment." The primary authority of the Coast Guard involves a determination of whether or not or under what conditions vessels will be permitted access to a proposed site and the operations to be conducted on facilities adjacent to the navigable water of the United States. Clearly, Coast Guard actions can have significant impacts on the location of terminals handling dangerous cargo.

(c) Findings and Conclusions

As a result of the case studies several regulations and agencies were identified as constraints by respondents as impediments to development. In particular, the separate permitting requirements of the State of Illinois were singled out as being redundant and unnecessary, because the state reviews and comments on federally issued permits. Even though some of the various Illinois agencies involved were compared favorably to their federal counterparts, it is an unnecessary duplication. Since the Corps of Engineers permit requirements often become the vehicle for bringing other laws to bear, the Corps was often identified (unfairly) as a barrier to development.

Laws governing dredging, particularly Section 404 of the Federal Clean Water Act were most often identified by the interviewees as causing problems. Anytime that public review or inter-agency coordination became necessary the permit process also became much slower.

IMPACT OF REGULATORY COMPLIANCE

During the course of the interviews, an attempt was made to quantify the impact of compliance with the various regulations for each particular project studied. The results are displayed in Table IV-4 . The figures indicate that much more time is involved in obtaining a permit than the 60-90 day average that is publicized. Due to the problems already mentioned, permitting for the case study projects took considerably more time involving additional costs over and above other "normal" compliance costs incurred. These costs are of two principal types: (1) inflationary costs resulting from delays in construction including higher prices for construction materials and interest expense; and (2) administrative and other related additional complaince costs. The analysis does not include inflationary cost except in the case of facility B where a figure for inflationary cost escalation was provided. These additional costs constitute the major impact of regulatory compliance.

Table IV-4

Cost Estimates - Time and Money - Due to Development Problems

Case Study Facility	Months to Obtain Permit	Additional Compliance Cost	Nature of Cost
A	4	N.A.	N.A.
B	9	250,000	Air and water quality permits
		400,000	Cost escalation
C	N.A.	N.A.	N.A.
D	N.A.	N.A.	N.A.
E	22	100,000	EIS
F	17-pending	N.A.	Alternative site search
G	N.A.	100,000	U.S. Fish and Wildlife Agency
		300,000	Regulatory compliance
H	15	N.A.	Section 404 permit

Note: N.A. = not available.

V - CONSTRAINTS ANALYSIS

This section of the report addresses the factors that can potentially constrain the projected levels of barge taffic in the GREAT III study area. The purpose of the section is to identify those factors and to evaluate the impacts if the constraints are not alleviated. The potential constraints analyzed are:

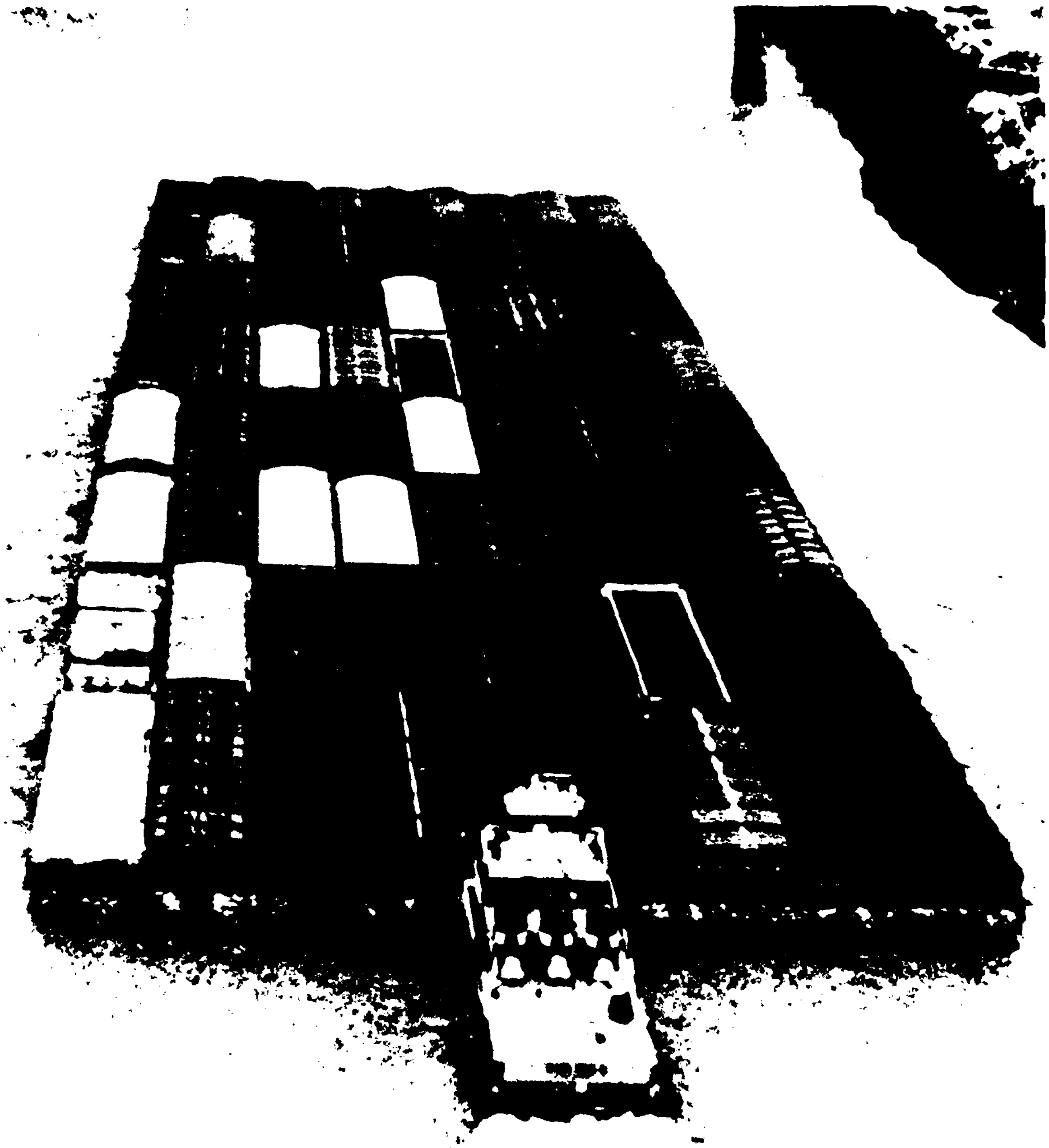
- Channel capacity
- Bridges
- Locks
- Fleeting
- Terminals
- Other navigational constraints
- Regulatory or legal constraints

Each of these constraints is discussed in detail under separate subheadings. Each discussion will include a description of how each factor can be a constraining influence, a description of the methodology, statement of findings, and a statement of conclusions.

CHANNEL CAPACITY

(a) Description of the constraint

Channel dimensions - both width and depth - are important determinants of channel capacity. These two factors determine the "instantaneous carrying capacity" of a particular channel. Carrying capacity is three dimensional. It is determined first by channel depth. Channel depth allows deeper loading of barges. Channel width determines the number of barges that can be carried abreast and the maximum beam of self propelled vessels. Channel width and bends together limit tow size. The curvature of bends determines the maximum overall length of tows that can safely navigate a particular river or channel. Channel capacity must also include a time dimension. The unit usually used is "annual throughput," that is, the amount of commerce that could be handled in a year. This is determined by the maximum safe speed, minimum safe interval between tows, and maximum tow size, especially length.



World record tow of 7[illegible] barges in [illegible]. Due to natural and man-made constraints, tows in the [illegible] area are limited to 3[illegible]-42 barges in open river stretches and 15 barges in pooled portions.

(b) Description of Methodology

In order to evaluate channel capacity for the GREAT III segment of the Mississippi River, several key assumptions were developed (based on NWS analysis). These assumptions are as follows:

- 65 percent empty backhaul
- Underway speed of 6.33 MPH
- Average tow size of 11.28 barges
- 1,400 tons per loaded barge
- Overall length of 1,200 feet
- Two mile separation between tows
- Year round operation
- 100 percent reliable channel (no complete blockages).

The first three assumptions are based on unpublished "Vessel Characteristics Survey" conducted by the St. Louis District Corps of Engineers for the Water Resources Support Center at Ft. Belvoir. This survey estimated statistics for the entire Mississippi River, tributaries and gulf systems. The data used here are for the entire Upper Mississippi from Cairo to Minneapolis. Strictly speaking, the average tow size for the slack water portion of the GREAT III study area will be less than 11.28 barges and the average for the open river portion below Locks 27 will be greater than 11.28 barges. There is no basis for specifying a different backhaul factor or underway speed for these two distinct parts of the GREAT III study area.

Having made these assumptions, annual throughput was estimated according to the formula presented on the following page.

Channel Capacity - Methodology

A = Average speed
B = Tow interval (length + separation)
C = Tow size
D = % empty backhaul
E = Lading per barge

$$\text{Capacity} = \text{No. of tows annually} \times \text{Loaded barges per tow} \times \text{Lading per barge}$$

$$\text{Number of tows} = \frac{365 \times 24}{(1/A \times B)}$$

$$B = \frac{5{,}280 + 1{,}200}{5{,}280}$$

$$\text{Loaded barges per tow} = C \times 1/2 \times (2-D)$$

$$\text{Annual Capacity in Tons} = \frac{365 \times 24}{\frac{1}{A}\ B} \times [C \times 1/2 \times (2-D)] \times E$$

$$\text{Annual Capacity in Tons} = \frac{365 \times 24}{\frac{1}{6.33}} \times 1.23 \times [11.28 \times 1/2\ (2-.65)] \times 1{,}400$$

In addition, discussions were held with three master pilots regarding identification of navigational constraints.

(c) Findings

Channel capacity, given the above assumptions, was estimated at 480 million tons per year based on present average conditions. The maximum throughput in the future will increase as average tow sizes increase from a present average of 11.28 barges per tow. Since the channel below Locks 27 can accommodate 25 barge tows, the theoretical maximum based on all tows having 25 barges would be 1,064 million tons. Assuming 1,500 tons per loaded barge would further increase the estimate to 1,140 million tons. Total traffic forecasted for the year 2000 according to the baseline scenario is 158 million tons. Clearly, channels will not constrain capacity in the future. However, this estimate is contingent upon adequate maintenance in the future. If maintenance is reduced for any reason, safety will probably be affected before capacity.

The master pilots interviewed noted that channel depth and width, 11.5 to 12 feet and 300 feet respectively, are constraints. They feel that the channel should be at least 13 feet deep and more than 300 feet wide to allow for safe and efficient navigation. Because loaded barges and towboats draw 9 feet of water, an additional 3 or 4 feet of channel are (deemed) necessary to provide adequate control and maneuverability. Moreover, since a 15-barge tow is typically 105 feet to 110 feet wide, a channel width of at least 300 feet is necessary if two oncoming tows are to pass one another without one tow having to pull over to one side of the channel and wait for the other to pass. Channel width should be greater than 300 feet at river bends, because the length of the tow (a typical 15-barge tow is over 1,100 feet in length) and the need for the towboat pilot to follow the river's turn make a much wider channel necessary.

The master pilots did not identify any "chronic" year round depth/width problems within the GREAT III reach. However, several other problems related to the channel and navigation were cited. These problems include:

- Channel markings
- Sunken barges
- Some fleeting locations
- Some shore facilities
- Shallow stretches

Table V-1 summarizes the navigational constraints cited by the pilots.

Table V-1

Constraint Analysis by Master Pilots

Major Constraints Cited by Master Pilots	Incidence of Constraint in GREAT III Area
Sunken Barges/Towboats	
- In Channel	4
- Along Either Bank	6
Areas Where Dredging is Needed	10
Navigational Aids	
- Buoys (placement)	8
- Lights	4
Bridges (because of poor navigational aids or shallow)	4
Fleets or Docks that Restrict Passage	
- Fleets	4
- Docks	3
Natural Conditions	
- Drafts/Swift Current	3
- Narrow Stretches/Bends	12
- Rock Bottom	1
Sailboats and Pleasure Craft	4

It must be noted that below St. Louis the Mississippi is a free flowing river and hence the severity of particular constaints will vary at different river stages. For example, during low water periods shallow areas, narrow stretches and bends, and sunken barges represent greater hazards than during normal water conditions.

Other general constraints and comments cited by the pilots were as follows:

- Waiting time at Locks and Dam 26.
- "Uncooperative" lock personnel at Locks and Dams 22 and 25.
- Ice blockage from St. Louis to Cairo during winter.
- Navigational aids dragged off station during spring thaw.

Bridges in GREAT III average approximately 50 years of age with the oldest 92 years. Modern tow sizes wre not considered when these bridges were designed and built. This bridge, while not in GREAT III, illustrates the problem.

- Bridge tenders do not open the bridges until the last moment.

- Greater number of constraints and degree of seriousness below St. Louis.

- Railroad bridges pose more problems than highway bridges (because of poor navigational aids).

- Approximately 10% of the buoys are off station from Keokuk to Cairo.

- Buoys are more critical than lights as navigational aids.

- Sunken barges, boats and other submerged features should be marked and the amount of water over them gauged.

(d) Conclusions

Based on the above analysis, channels and channel capacity were found not to be constraining. Although problems were cited, these were only minor, and no chronic year round depth/width problems were identified.

BRIDGES

(a) Description of Constraint

Bridges spanning the river can constitute constraints to navigation in two ways. One is the size of the horizontal opening that can cause vessels to slow down and loose transit time or increase the risk of collision. The other constraint is from opening type bridges that cause delays and increase the risk of collision by not opening promptly. Bridge passage can be further complicated by inadequate navigation aids, high water, cross currents, wind, channel alignment, and other natural conditions.

(b) Description of Methodology

To identify problem bridges, three sources of information were referenced. First of all, the master pilots had been queried on each bridge in the GREAT III reach as to whether there were any particular problems with any of them. Secondly, the NWS also addressed this issue. Third, information was provided by the bridge section of the Second Coast Guard District concerning problem bridges. These three sources of information were combined and compared for the analysis.

(c) Findings

Within the GREAT III reach, 17 bridges span the main channel, 2 bridges span the Chain of Rocks Canal, and one bridge is under construction. Two of the 17 bridges are railroad swing spans. These are the Burlington Northern bridge at Alton at mile 202.7, and the Illinois Central Gulf bridge at Louisiana at mile 282.1.

Railroad bridges were cited by the pilots as posing more problems than highway bridges, since the highway bridges can usually be constructed with greater horizontal and vertical clearances. Generally, railroad bridge navigational aids, i.e., lights, are not maintained as well as those on highway bridges, nor are the railroad bridges themselves maintained as well. The swing spans also have narrower horizontal clearances.

Thirteen of the nineteen bridges in the study area are identified as having horizontal clearances of 400 feet or more. The narrowest clearances are at the two railroad swing spans. These clearances are 200 feet at Alton and 197 feet at Louisiana. The bridge at Alton is integrated into the structure of Locks and Dam

26,and does not by itself presently constrain traffic. When the new lock and dam structure downstream is completed, the bridge will be rebuilt as a horizontal lift span and remain in place. It may then pose a problem. The spans of both these swing bridges are narrow enough to constrain traffic to one way passages.

Pilots of river boats also sometimes use the marker lights on the movable bridges as navigation aids, a use for which they are not designed. When bridge operators open the bridges late, the use of these marker lights as navigation aids is impaired, and pilots relying on these lights may experience difficulties. This increases transit time and seriously affects safety because of the vessel's difficulty in maintaining alignment in the channel. This is a major complaint of towboat captains.

Table V-2 lists the constraining bridges as identified by the analysis. As indicated, only 7 of the 17 bridges pose any problems to navigation. The causal factors for the problems include:

- Lights
- Drafts (currents)
- Upstream bend
- Restrictive Clearances

Table V-2

Problem Bridges

Name	Mile	Nature of the Problem
Cairo HW (Route 60)	1.4	Drafts
Thebes RR	43.7	Lights, drafts, upstream bend
Eads	180.0	Restricted vertical clearance
McKinley	182.5	Drafts
Merchants RR	183.2	Drafts
Louisiana RR	282.1	Narrow clearance, currents
Louisiana HW	283.2	Drafts

Note: NWS identification of problem bridges is based on Coast Guard statistics and other published sources.

None of the bridges restrict tow size, and although all bridges (except the two railroad bridges at Locks and Dam 26) will accommodate two-way traffic, this is not practiced for safety reasons at bridges in the St. Louis harbor area.

Safety is considered a serious problem at certain bridges which include:

- Cairo Highway Bridge
- Thebes Railroad Bridge
- ICG Railroad swing span at Louisiana, Mo.
- Louisiana Highway Bridge.

High accident rates are associated with these bridges, particularly with the Cairo highway bridge and the Thebes railroad bridge. A relatively high incidence of rammings occur at all of these bridges.

(d) Conclusions

Bridges in the GREAT II area do not represent a constraint to navigation to the extent that they will cause dislocations from one transportation mode to another. Over time the safety and delay problems have been relatively minor, however, the potential for more serious accidents with subsequent environmental and economic consequences exists. Drastic action to correct these conditions does not appear warranted, but the problem cannot be ignored and should be vigorously addressed through existing programs.

Locks and Dam 26 at Alton, Illinois has been a major constraint to navigation. Note the many barges along the banks waiting lockage.

Locks and Dam 26 at Alton, Illinois has been a major constraint to navigation. Note the many barges along the banks waiting lockage.

LOCK CAPACITY

(a) Description of Constraint

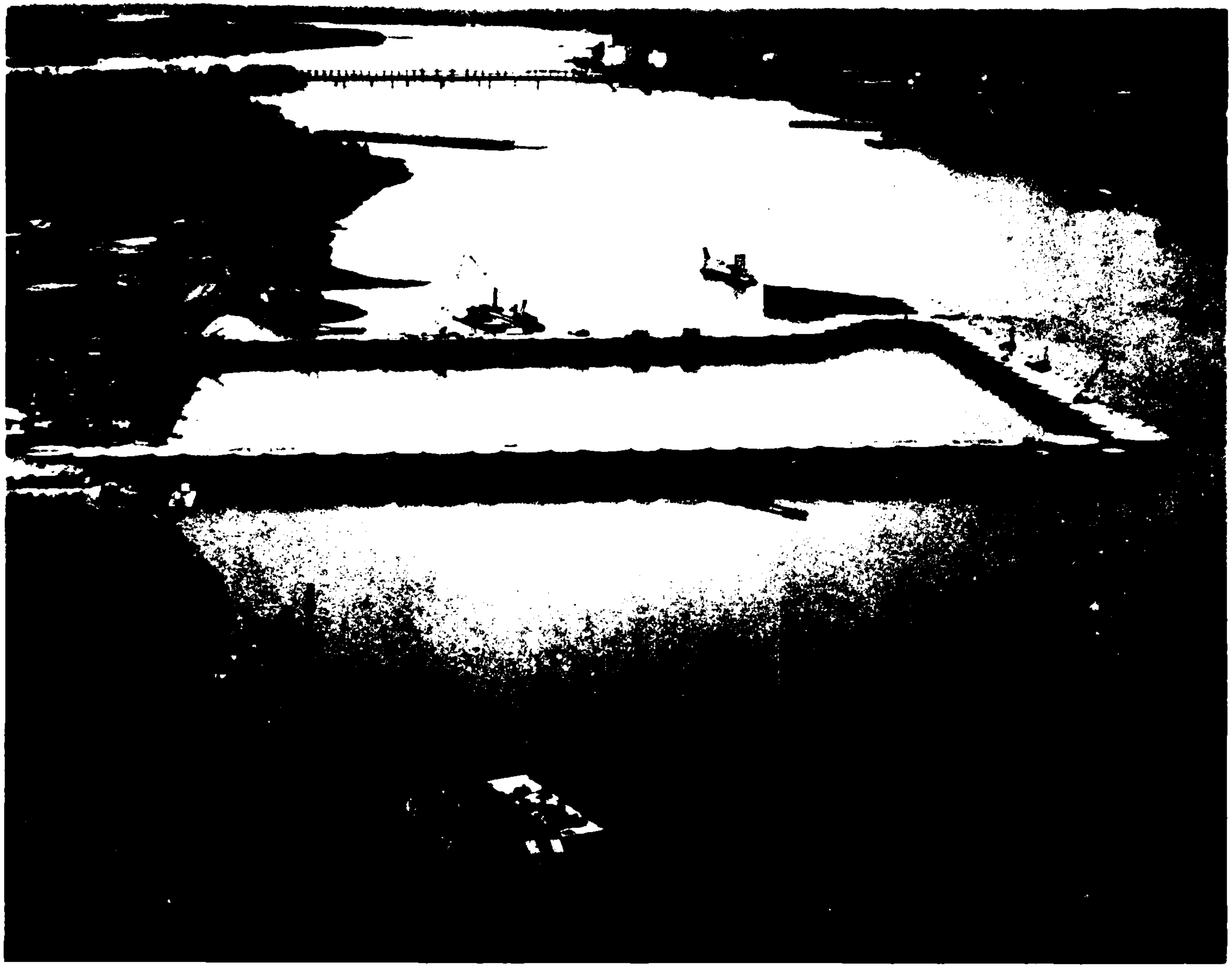
Locks exist at four sites in the study area (chamber dimensions in parentheses):

- Lock and Dam 24 at mile 273.4 near Clarksville, Missouri. (110' x 600')
- Lock and Dam 25 at mile 241.4 near Winfield, Missouri. (110' x 600')
- Locks and Dam 26 at mile 202.9 at Alton, Illinois. (110' x 600' and 110' x 360')
- Locks 27 at mile 190.3 at Granite City, Illinois. (110' x 600' and 110' x 1200')

Locks are potential capacity constraints for three reasons. First, chamber dimensions can restrict tow size and configuration. Second, downtime due to an inoperable lock as a result of ice, collision repair, or routine maintenance. Third, and most important, the time required for tows to transit locks far exceeds the time required for tows to transit open channels or bridges. Thus, locks are the primary constraint and have been subjected to detailed analyses in other studies.

(b) Description of Methodology

Rather than devote study resources to re-analysis of locks, it was decided to rely on two other ongoing studies, the UMRBC Master Plan effort and the National Waterways Study. Both of these studies estimated lock capacities in some detail and prepared forecasts of future traffic at locks. Since the traffic forecasts prepared for GREAT III were derived from both of these studies, little additional insight would be gained from yet a third analysis. The findings of these two studies are summarized in Table V-3.



Construction proceeds on the new Lock and Dam 26 at Alton, Illinois. It is located 2 miles below the existing lock, highway, and railroad bridges visible in the background.

Table V-3

Lock Capacity Shortfalls
(Millions of Tons)

	Source	Lock Name 24	25	26	27
UMBRC Findings[1]	Master Plan Draft Report	(1.9)[2]	6.4	10.6	(89.8)[2]
NWS Findings[3]	NWS Findings and Conclusions	(9.0)[2]	(7.3)[2]	24.0	(31.5)[2]

Notes: (1) UMRBC Baseline Scenario in the year 2000.
(2) Parentheses () denote a negative shortfall, or reserve capacity.
(3) NWS Baseline Scenario in the year 2003.

The wide difference in capacity shortfall estimates between the UMRBC Master Plan and the NWS result `th from different capacity estimating procedures and data, and from different forecasts. The UMRBC forecasts of traffic are higher than the NWS forecasts because of the data adjustments mentioned in Section III of this report. The UMRBC lock capacity estimates are derived from more recent data than the NWS estimates and different procedures. The findings are consistent except for Lock 25. The UMRBC capacity estimates were used for the sake of consistency.

(c) Findings

The most important finding with regards to locks concerns Locks and Dam 26. Under all forecasts Locks and Dam 26 is expected to be an early constraint to future traffic. The capacity shortfall at Lock and Dam 25 identified in the UMRBC analysis is less than the shortfall at Locks and Dam 26. The difference between the UMRBC and the NWS analysis of Lock 25 results from the fact that the UMRBC capacity estimate is substantially lower and the traffic forecast is somewhat higher than the corresponding NWS values. The capacity estimate utilized for the UMRBC Master Plan was based on different data and methodologies.

Also, it should be pointed out Lock and Dam 25 becomes a constraint late in the study period and only if additional capacity above the new single 110' x 1,200' chamber currently under construction is added at Locks and Dam 26. Thus, Lock and Dam 25 is controlled by Locks and Dam 26. Further, Lock and Dam 25 also is affected by the ability of Lock and Dam 22, immediately upstream of the GREAT III study are to accommodate traffic. Lock and Dam 22 is also forecast to become a constraint either prior to or at about the same time as Lock and Dam 25. Thus, regardless of which analysis of Lock and Dam 25 is accepted as correct, Lock and Dam 25 is at worst a secondary constraint in the study area, and then only at the end of the study period. For GREAT III purposes, the UMRBC analysis of lock constraints has been adopted.

(d) Conclusions

Locks are and will remain the primary constraint to commercial navigation in the study area. The primary problem is Locks and Dam 26. Lock and Dam 25 is also expected to be a constraint.

FLEETING

(a) Description of Constraint

Fleets or fleeting areas are a component of the water transportation system. These are areas outside the main channel where barges are stored while awaiting pickups and delivery to terminals and reconfiguration for linehaul operations. Fleeting areas are analogous to railroad yards where cars are temporarily stored and trains are assembled and disassembled. Fleets are potential constraints to both shipments and receipts of goods, and to through tows which are reconfigured.

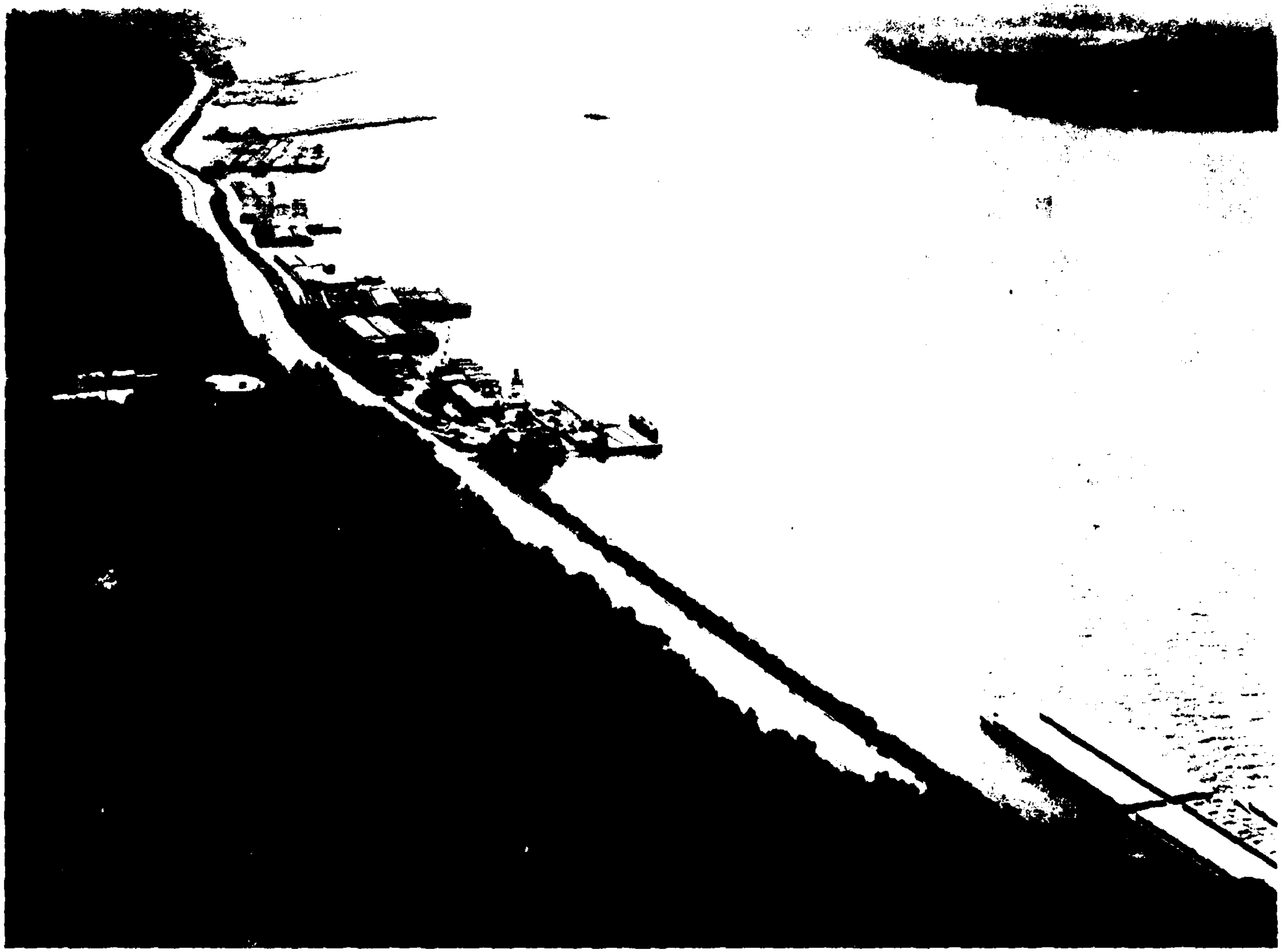
Fleeting areas covered by this analysis do not include small holding areas for small numbers of barges associated with terminals. These are considered to be integral components of terminals. Also excluded from this analysis are a few fleeting areas dedicated to specific large single-commodity terminals whose owners do not provide fleeting services to others. Thus these fleets are excluded from the capacity available for general use.

(b) Description of Methodology

The approach used to evaluate fleeting constraints encompassed several steps. These were.

1. Completion of a current inventory of fleeting areas in the GREAT III study area.

2. Development of additional data to support the analysis.



Fleeting is a necessary part of waterway transportation. *Shortages are predicted* in the GREAT III area from Locks 27 to river mile 136.

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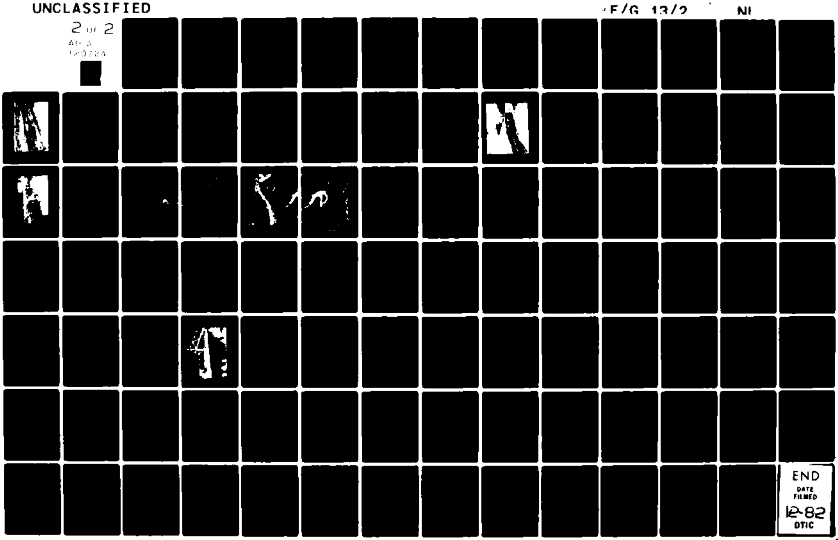
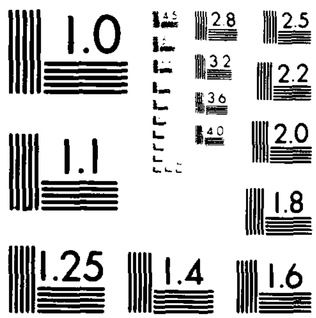



1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0

3. Development of traffic forecasts for individual sub-reaches in the GREAT III study area.

4. Review of one existing study for the Port of Metropolitan St. Louis. ("Analysis of Fleeting in the Port of Metropolitan St. Louis" by Lonnie E. Haefner for the Bi-State Development Agency.)

The measure of capacity and demand is the number of spaces in fleets. To compare the demand and capacity it is necessary to convert tonnage into barges and barges into space requirements. The capacity equation used is similar to Haefner's and is specified below:

$$\text{Theoretical Annual Capacity} = \text{Barge Spaces} \times \text{Low Flow Reduction} \times \text{Seasonal Adjustments} \times \text{Turnover}$$

The barge spaces are derived from the inventory. These were documented in Section II.

The low flow reduction was applied to fleeting areas identified by operators in the inventory as subject to restrictions on activity during low flow conditions. All of the affected fleets are below Locks 27. This is logical since pool stages above Locks 27 are stabilized by the dams constructed for this purpose. The adjustment factor applied was weighted to take into account the fact that only a fraction of the barge spaces below Locks 27 are affected. The reduced capability occurs when the St. Louis gauge is at zero or below according to the affected operators. No operators reported any other operating problems due to either low flow or high water conditions.

The seasonal adjustment is a means of recognizing the effect of seasonal variations in traffic flows. Since no data on seasonal variations in demand for fleeting services were available, a seasonal adjustment based on seasonal variations at Locks and Dam 26 and Locks 27 was used as a proxy for seasonality in the use of fleeting areas.

The turnover of fleeting areas is the number of times that a barge space within a fleet will be normally used. The value of 100 is derived from the data provided by operators who stated that a barge will usually stay in a fleet for three to three and one half days. A 365 day year divided by 3.5 yields a value of 104.3. This was rounded to 100.

The theoretical capacity was further reduced by 20 percent to estimate effective capacity. Effective capacity is the level of utilization at which costs can be expected to increase rapidly as efficiency declines. Under these conditions extra capacity is likely to be added by operators.

The capacity estimates for each sub-reach defined for this analysis are shown in Table V-4 below.

Table V-4

Fleeting Capacity Analysis
Year 2000

	Capacity by Sub-Reach				
	Pools 24 & 25	Pool 26	Pool 27	Pool 27 to Mile 163	Mile 163 to Cairo
Available Spaces	0	250	680	1,765	445
Low Flow Reduction	1.0	1.0	1.0	0.95	0.95
Seasonal Adjustment	0.90	0.90	0.90	0.90	0.90
Turnover	100	100	100	100	100
Annual Theoretical Capacity in Barges	0	22,500	61,200	150,908	38,048
Annual Effective Capacity in Barges (80% of Theoretical)	0	18,000	48,960	120,726	30,438

The sub-reaches defined for this analysis combine pools 24 and 25, and treat pools 26 and 27 separately. The remainder of the GREAT III study area below Locks 27 was further subdivided at river mile 163. This division was selected based on the location of existing fleets below the Jefferson Barracks Bridge. This location was considered important because most of the port activity of St. Louis occurs above this point and this is presently the lower limit for most reconfiguration activities of linehaul tows containing more than 15 barges.

The next step in the analysis was to forecast potential fleeting requirements so that these could be compared to capacity on a sub-reach basis. The pool specific forecasts for the baseline scenario were utilized for this purpose. Two additional assumptions were also made. First, it was assumed that all shipments and receipts below Locks 27 originate or terminate above mile 163. While this appears to be an extreme assumption, a very high percentage of total originations and terminations below Locks 27 do take place above mile 163. It was also assumed that all through tows would be reconfigured between Locks 27 and mile 163. While many tows would not reconfigure at all, placing all reconfigurations that would occur within this sub-reach is logical. Such reconfiguration as would occur, would be most likely to take place here to maximize the utilization of greater channel dimensions below mile 163.

In order to convert tonnages into barge handling requirements it was necessary to specify barge ladings and the number of handlings. Ladings were assumed to be 1,400 tons. Each originating or terminating barge was assumed to be handled twice by a fleet. Each through loaded barge was assumed to be handled 1.65 times to reflect the need for some empty backhaul. The results of the analysis are summarized in Table V-5 on the following page.

Table V-5

Evaluation of Fleeting Capacity Shortfalls in Baseline Year 2000

	Sub-Reaches				
	Pools 24 & 25	Pool 26	Pool 27	Pool 27 to Mile 163	Mile 163 to Cairo
Shipments and Receipts					
Tons (1,000)	3,400	4,200	11,500	48,600	0
Barge Ladings (Tons)	1,400	1,400	1,400	1,400	1,400
Handlings	2	2	2	2	2
Annual Barges	4,857	6,000	16,429	69,429	0
Through					
Tons (1,000)	0	0	0	90,618	0
Barge Ladings (Tons)	1,400	1,400	1,400	1,400	1,400
Handlings	1.65	1.65	1.65	1.65	1.65
Annual Barges	0	0	0	106,800	0
Total Annual Barges	4,857	6,000	16,429	176,229	0
Capacity in Annual Barges	0	18,000	48,960	120,762	30,438
Shortfall (Excess) in Annual Barges	4,857	(12,000)[1]	(32,531)[1]	55,467	(30,438)[1]
Shortfall (Excess) in Barge Spaces	49	(120)[1]	(325)[1]	554	(304)[1]

Note: 1. Parentheses () denote a negative shortfall, or excess capacity.

The calculations displayed in Table V-5 transform tonnage commodity flows into annual barge handling requirements. These estimates are in turn transformed into barge spaces by dividing the annual requirement by the turnover rate of 100.

The most significant result is an expected shortfall in the sub-reach from Locks 27 to mile 163. The estimated shortfall in 2000 for this sub-reach is 554 barge spaces. Applying the same methodology to the 1990 forecast for this sub-reach yields a shortfall of 122 barge spaces. This shortfall would be reduced somewhat under the user charge, rail merger, and low use scenarios. Under the high use scenario, increased coal traffic will exacerbate the shortfall somewhat. However, significant fleeting areas dedicated to existing coal terminals not included in the capacity estimates would absorb more of the coal traffic which is the only commodity different from the baseline in the high use scenario.

The assumptions employed have identified a problem in a particular sub-reach. The numerical estimate itself must be interpreted in light of those assumptions. The methodology probably overstates the actual problem to some degree in the sub-reach from Locks 27 to mile 163.

The apparent shortfall in Pools 24 and 25 is probably not a serious problem. These two pools include approximately 60 river miles and contain a small number of isolated terminals separated by relatively great distances. Both the small volume of shipments and receipts and the distances between terminals create circumstances where fleeting areas can be used to advantage in conjunction with larger linehaul tows. These terminals are probably served directly by small linehaul tows made up in pools 26 and 27. Thus, the apparent excess capacity in pools 26 and 27 is probably also overstated to the extent that traffic to and from pools 24 and 25 utilize fleeting areas in pools 26 and 27.

While fleeting capacity is clearly adequate to serve total shipments and receipts in pools 26 and 27, some of this capacity also serves through traffic waiting to transit Locks and Dam 26. This usage of fleeting areas is not undertaken for purposes of reconfiguration. Rather, it is a requirement for barge and towboat storage generated by the congestion which will be alleviated when the replacement Locks and Dam are completed. This usage has not been captured in the analysis in Table V-5. Indeed there may be a short-term requirement for additional fleeting areas in pools 26 and 27 until the new Locks and Dam are available.

Also, although aggregate fleeting capacity in these pools appears adequate to handle shipments and receipts, not all terminals have ready access to fleeting areas. No precise statement of this problem, other than generalized complaints, could be derived from the interviews, however. Some fleet operators cope with such problems by increasing the turnover of their capacity. One operator indicated that barges normally were held in his fleet for less than 24 hours.

Below mile 163 the apparent surplus of spaces is a result of the assumptions placing all fleeting requirements above mile 163. No terminal operator below mile 163 either indicated or anticipated a problem, however. The existing fleeting capacity below mile 163 is distributed along the river close to the various terminals. At the present time, no fleeting areas have been established at the lower end of the study area on the Mississippi River in the vicinity of Cairo. One fleeting area is operated on the Mississippi just south of Cairo. Also, many fleeting areas are in use on the Ohio in the vicinity of Cairo. New fleeting capacity requirements are expected here as linehaul operators make increasing use of tows larger than 25 barges on the Mississippi River below Cairo. No specific forecast of this requirement has been made.

(c) Comparisons With Other Analyses

As mentioned above, one existing current study of fleeting problems was also reviewed. The other study (by Haefner) also identified a fleeting capacity shortfall in the Port of Metropolitan St. Louis of similar magnitude, namely 535 spaces by the year 2000. Although the capacity equation used by Haefner is virtually identical to the equation used here, there are several differences in the two analyses that should be noted. First, Haefner identified far fewer fleeting spaces in the same area covered by this study. Second, Haefner utilized a longer average holding time for barges. Third, Haefner used different forecasts of future requirements that are not comparable. Finally, Haefner used a different reduction factor. Nevertheless, the two studies yielded similar results.

(d) Findings

The major finding of this analysis is a shortfall of fleeting capacity within the Port of Metropolitan St. Louis between Locks 27 and mile 163. Other fleeting requirements will change as a result of the completion of the new Locks and Dam 26 and an expected increase in reconfiguration of linehaul tows at Cairo.

(e) Conclusions

Fleeting capacity is not a widespread problem throughout the study area. Some terminal operators experience occasional delays in obtaining barge movement services in and out of their facilities. Present facilities in the sub-reach corresponding to the main port area of the Port of Metropolitan St. Louis will not be adequate to serve long term requirements and additional capacity will be required.

TERMINAL CAPACITY

(a) Description of Constraint

Barge transportation is appropriate for high-volume shipments of bulk commodities between two waterside locations where the cargo is loaded and unloaded at terminals. These terminals can be either public or private. Public terminals typically are general commodity facilities, whereas private terminals handle one or more products of a particular company. A possible constraint to growth of barge traffic is the lack of adequate terminal capacity to handle projected traffic flows.

(b) Description of Methodology

Several steps were involved in analyzing terminal capacity. First, an inventory of terminals was conducted. This inventory, generated by phone interviews and Corps of Engineers' data, produced the handling capacity estimates for all terminals identified in selected commodity groups. The commodity groups selected were grain, coal, petroleum, chemicals, nonmetallic minerals, cement and stone, and iron steel products. These seven were chosen because they collectively constitute over 90 percent of the barge traffic in the GREAT III area.

In certain cases, terminal operators refused to provide capacity information. For these terminals, actual 1978 tonnage handled by the terminals was used as a surrogate for estimated capacity. Estimated capacities for all terminals within a commodity designation were added together in order to obtain a measure of total effective capacity (for each commodity group). These data are shown in Table V-6.

Table V-6

Estimated Terminal Capacity

Commodity Group	Estimated Capacity of Interview Sample (Thousands of Tons)	1978 Actual Throughput of Non-respondents (Thousands of Tons)	Total Effective Capacity (Thousands of Tons)
Grain	12,603	5,409	18,012
Coal	39,728	3,522	43,250
Petroleum Products	11,726	3,763	15,489
Chemicals	3,454	826	4,283
Nonmetallic Minerals	2,658	494	3,152
Cement and Stone	5,400	1,791	7,191
Iron and Steel	2,784	-	2,784

Next, ratios of projected traffic (shipments and receipts) to total effective capacity were calculated. That is, the levels of forecasted traffic for the years 1990 and 2000 were divided by the total effective capacity for each of the seven commodity groups. These calculations are shown in Table V-7 and represent the extent to which projected traffic can be absorbed by current capacity. Stated another way, they represent the extent to which existing capacity will be utilized by projected traffic levels.

Table V-7

Projected Baseline Traffic as a Percentage of Capacity

Commodity	Total Effective Capacity	Projected Baseline Traffic 1990	Projected Baseline Traffic 2000	Utilization of Capacity 1990	Utilization of Capacity 2000
		(Thousands of tons)		(Percent)	
Grain	18,012	10,833	15,167	60	84
Coal	43,250	21,804	28,845	50	67
Petroleum Products	15,489	8,601	8,666	56	56
Chemicals	4,283	2,871	4,338	67	101
Nonmetallic Minerals	3,152	1,208	1,066	38	34
Cement & Stone	7,191	3,144	3,406	44	47
Iron & Steel	2,784	2,367	2,746	85	99

At this point of the analysis, these ratios were compared to two criteria in order to determine new terminal needs: an 80 percent capacity utilization criterion and a 60 percent capacity utilization criterion were used. Terminal capacity was deemed to be a constraint if the ratios equalled or exceeded these utilization rates. The 80 percent criterion corresponds to a level of utilizaiton at which the physical plant and labor would be strained to handle any more tonnage. The 60 percent criterion accounts for the competitive element in bringing additional terminal capacity on line. It was judged that at or above 60 percent utilization competitive forces would induce either expansion of capacity by existing market participants, or the building of new facilities by new market entrants. Under competitive conditions, an expansion of capacity would likely occur between 60 and 80 percent utilization for a particular commodity. (The 80 percent criterion was based on a two shift operation whereas the 60 percent criterion corresponds roughly to a shift and a half operation).

Having determined what commodities will be constrained by present terminal capacity, the next step was to determine the new terminal requirements. This was accomplished by first determining the shortfalls in terminal capacity for each constrained commodity group. The shortfall in capacity for a particular commodity was calculated by subtracting 80 percent (60 percent) of total effective capacity tonnage from the projected levels of traffic for years 1990 and 2000. Then, these shortfalls were divided by the respective average handling capacity (excluding extremes) of those terminals within a commodity group for which estimated capacity data was available. (Those terminals for which 1978 tonnage figures were substituted were not used to calculate the average handling capacity). These calculations yielded the number of new terminals required. As terminals were added for 1990 and 2000, the shortfall in capacity was duly reduced by the average capacity figure for the respective commodities to reflect the accretion of new capacity.

The shortfalls in capacity differed under the various scenarios, however, the average terminal capacity figures used remained constant and are shown in Table V-8 on the following page.

Table V-8

Average Terminal Capacity

Facility Type	Average Capacity
Grain	740,000 tons
Coal	3,900,000 tons
Chemical	363,000 tons
Iron and Steel	545,000 tons

(c) Findings

Additional terminal capacity was found to be needed for four commodity groups - grain, chemicals, coal, and iron and steel products. This will necessitate either expansion of existing terminals or the building of new ones to handle the increased traffic. Table V-9 and Table V-10 present the additional terminal requirements according to scenario and capacity utilization criteria. Under the 80 percent capacity utilization criterion, the greatest need is for chemical processing facilities in the year 2000. Under the 60 percent capacity utilization criterion, the greatest need is for more grain elevators, followed closely by chemical facilities. Also, under the 60 percent criterion, coal transshipment facilities are found to be needed. This same pattern of terminal needs emerges under the user charge scheme although they are somewhat less.

New terminal requirements under the rail merger scenario are the same for grain, chemicals, and iron and steel as those for baseline, low use, and high use. Terminal capacity for coal which arose as a constraint according to the 60 percent rule is not a problem under the rail merger case due to diversion of coal. Sufficient capacity exists to absorb the changes in traffic for all other commodities.

Table V-9

Additional Terminal Requirements

Scenario/ Commodity	60% Criterion 1990	60% Criterion 2000	Total	80% Criterion 1990	80% Criterion 2000	Total
Baseline:						
Grain	1	5	6	--	1	1
Coal	--	1	1	--	--	--
Chemicals	1	4	5	--	3	3
Iron & Steel Products	1	1	2	1	1	2
Low Use:						
Grain	--	5	5	--	1	1
Coal	--	1	1	--	--	--
Chemicals	1	4	5	--	2	2
Iron & Steel Products	2	1	3	1	1	2
High Use:						
Grain	1	5	6	--	1	1
Coal	--	2	2	--	--	--
Chemicals	1	4	5	--	3	3
Iron & Steel Products	1	1	2	1	1	2

Table V-10

Additional Terminal Requirements

User Charge

Scenario/ Commodity	60% Criterion 1990	60% Criterion 2000	Total	80% Criterion 1990	80% Criterion 2000	Total
Baseline:						
Grain	--	4	4	--	--	--
Coal	--	1	1	--	--	--
Chemicals	--	4	4	--	1	1
Iron & Steel Products	1	1	2	--	--	--
Low Use:						
Grain	--	3	3	--	--	--
Coal	--	1	1	--	--	--
Chemicals	--	3	3	--	1	1
Iron & Steel Products	1	1	2	--	1	1
High Use:						
Grain	--	4	4	--	--	--
Coal	--	2	2	--	--	--
Chemicals	--	4	4	--	1	1
Iron & Steel Products	1	1	2	--	--	--

Few private docks handle iron and steel products exclusively. Most iron and steel tonnage is handled by general commodity terminals. Therefore, the determination of additional terminal requirements were based on the average handling capacity of general commodity terminals that indicated they handled a substantial amount of iron and steel tonnage.

The City of ST. Louis Municipal Dock, operated by ST. Louis Terminals Corp, handles all types of commodities originating or destined to the GREAT III region.

(d) Acreage Requirements Due to New Terminal Needs

Having estimated the number of new terminals that need to be brought on line by the years 1990 and 2000, the amount of acreage required for these terminals can be estimated. The number of acres per type of terminal needed used in this calculation are listed in Table V-11 below.

Table V-11

Acreage Estimates Per Type of Terminal Needed

Type of Terminal	Acres per Terminal
Grain	20
Coal	120
Chemicals	50
Iron and Steel Products	85

These acreage estimates per terminal type include estimates for only the transfer facility in the case of grain and coal; for chemicals and iron and steel products, acreage required for a processing plant is also included in the estimates. The acreage estimate required for a grain terminal includes only the transfer facility because unless further processing will take place (e.g., a flour mill) to transform the grain into other products, no additional acreage should be needed. If a flour mill or other processing plant should be desired in combination with the transfer facility, it can be located further inland. Prime riverfront property is not required for the processing mill. Therefore, the acreage estimate includes only the amount of land needed for the grain transfer facility.

Similarly, further processing of coal at the terminal is unlikely so that the amount of land required is dictated by the transfer facility alone. Additional land might be required if coal blending were to be undertaken at terminal sites. Two examples of coal transfer facilities exist already in the Great III area, American Commercial Terminals and Cora Coal docks.

Using these acreage estimates in conjunction with the number of new terminals estimated to be required, the total amount of acres required was estimated. Estimates are provided under all scenarios according to both the 60 percent and 80 percent new terminal criteria for the years 1990 and 2000. These estimates are presented in Table V-12 and Table V-13.

Table V-12

Land Requirements

Scenario/ Commodity	60% Criterion 1990	60% Criterion 2000	Total	80% Criterion 1990	80% Criterion 2000	Total
Baseline:						
Grain	20	100	120	-	20	20
Coal	-	120	120	-	-	-
Chemicals	50	200	250	-	150	150
Iron & Steel Products	85	85	170	85	85	170
Low Use:						
Grain	-	100	100	-	20	20
Coal	-	120	120	-	-	-
Chemicals	50	200	250	-	100	100
Iron & Steel Products	170	85	255	85	85	170
High Use:						
Grain	20	100	120	-	20	20
Coal	-	240	240	-	-	-
Chemicals	50	200	250	-	150	150
Iron & Steel Products	85	85	170	85	85	170

Table V-13

Land Requirements

User Charge

Scenario/ Commodity	60% Criterion 1990	60% Criterion 2000	Total	80% Criterion 1990	80% Criterion 2000	Total
Baseline:						
Grain	-	80	80	-	-	-
Coal	-	120	120	-	-	-
Chemicals	-	200	200	-	50	50
Iron & Steel Products	85	85	170	-	-	-
Low Use:						
Grain	-	60	60	-	-	-
Coal	-	120	120	-	-	-
Chemicals	-	150	150	-	50	50
Iron & Steel Products	85	85	170	-	85	85
High Use:						
Grain	-	80	80	-	-	-
Coal	-	240	240	-	-	-
Chemicals	-	200	200	-	50	50
Iron & Steel Products	85	85	170	-	-	-

Cumulative acreage required under the various scenarios is summarized in Table V-14 below:

Table V-14

Cumulative Acreage Required

Scenarios	Acreage Requirements	
	60%	80%
Baseline	660	340
Low Use	725	290
High Use	780	340
User Charge - Baseline	570	50
User Charge - Low Use	500	135
User Charge - High Use	690	50
Rail Merger - Baseline	540	340
Rail Merger - Low Use	605	290
Rail Merger - High Use	540	340

Like the impact on new terminal requirements, the user charge scenarios moderately reduce the acreage requirements. Also, the rail merger scenario generates no terminal requirements for coal and land requirements are also less. The maximum acreage requirement is under the high use scenario - 780 acres.

(e) Conclusions

Commodities requiring additional terminal capacity are grain, coal, chemicals and iron and steel products. Actual new terminal requirements will probably range between the 60 percent rule and the 80 percent rule, and will depend upon the competitive environment within each affected industry. Finally, traffic diversion resulting from user charges and/or rail mergers will moderately reduce new terminal requirements.

OTHER NAVIGATIONAL CONSTRAINTS

Discussions with master pilots revealed other navigational constraints. These constraints were presented earlier in Table V-1 and include:

- Channel dimensions
- Sunken barges/towboats

- Navigational aids placement
- Narrow stretches/bends
- Sailboats and pleasure craft
- Winter navigation

Most of the problems cited above occur at points between St. Louis and Cairo, the "Middle Mississippi" which is a free flowing stretch of the river. Hence, the river is more unstable below St. Louis and the severity of the constraints depends upon the water level.

(a) <u>Channel Dimensions</u>

Channel dimensions are considered constraints. The pilots noted that channel depth should be at least 13 feet deep rather than 11.5 to 12 feet deep. The added depth would allow greater control and maneuverability. Also, they consider a 300 foot width as inadequate. A greater than 300 foot width would allow more efficient and safer passing of tows, particularly at bends.

(b) <u>Sunken Barges/ Towboats</u>

Sunken barges and towboats are navigational constraints when they are in or near the channel, especially during low water periods. Four sunken barges in the channel were cited by the pilots. The specific locations are

- Mile 8.7
- Mile 15.5
- Mile 35.5
- Mile 74.8

Sunken barges either restrict depth or width causing navigational and safety problems.

(c) Navigational Aids Placement

Navigational aids can present a constraint to barge traffic when they are not functioning properly. This could happen as a result of being dragged off station by ice or vessels, sunk or missing, or from rapid changes in river conditions that require relocation of the aid. Seven locations were identified where navigational aids are difficult to maintain, or where their location at various river stages is critical.

- Mile 23 - Dogtooth Bend
- Mile 39 to Mile 44
- Mile 46.4 - Grays Point
- Mile 64 to Mile 67
- Mile 94 to Mile 95
- Mile 116 to Mile 118
- Mile 130 to Mile 131

Navigational aid maintenance has improved substantially in the last several years according to the pilots. Pilots noted that from Keokuk to Cairo approximately ten percent of the buoys are off station as opposed to 50 percent in the past.

(d) Narrow Areas/ Bends

The pilots noted 18 locations where the channel is either narrow or bends, thus hampering safe navigation. These locations are:

- Mile 3 - Greenfield Bend
- Mile 13 to Mile 15 - Greenleaf Bend
- Mile 24 - Sliding Towhead
- Mile 23 - Dogtooth Bend
- Mile 31 - Price Landing
- Mile 46 - Grays Point
- Mile 48 - Cape Bend

- Mile 54 - Cape Rock
- Mile 84.6 - Brunkhorst towhead
- Miles 94-95 - Backbone
- Mile 105 - Fords coal dock
- Mile 125.5 to Mile 127.8
- Mile 135 - Fort Chartres
- Mile 160.6 - Meramec River
- Mile 170 - Street Oil Terminal
- Mile 172 to Mile 177
- Mile 197 to Mile 199
- Mile 289.5 to Mile 290.5

(e) Sailboats/ Pleasure Craft

Only minor problems were noted concerning safety hazards or constraints posed by sailboats and other pleasure craft. The principal segment where recreational use of the river is the heaviest and where problems were cited is mile 200 to mile 222. From Locks and Dam 26 through the Grafton area many sailboats are on the water requiring extra navigational expertise by towboat operators to avoid any incidents. Two particular problems were mentioned: first, sailboats and pleasure craft cause delays at Locks and Dam 26; second, recreational boaters (in this and other areas as well) generally run the channel side of the buoys, when they could run the other side and be out of the way, as there is enough depth to do so.

Although no serious problems are posed by recreational boaters, any problems that do exist are exacerbated after dark. It is then that boaters have a tendency to make irrational moves and towboat captains must keep careful watch.

(f) Winter Navigation

Constraints to navigation during the winter months are few for this segment of the river. One constraint which occurs during the winter months is the problem with ice blockage. At certain

An ice gorge blocks this lock entrance. It can also block open river stretches and affects navigational aids.

times from St. Louis to Cairo, when the Ohio River is high relative to a lower state for the Missouri and Mississippi Rivers, and when there are extremely cold temperatures, ice packs to the bottom and creates a dam. Sometimes the ice will pack to 30 feet high forming a series of gorges from Cairo to Cape Girardeau, a 52-mile stretch. Hence, when the volume of water is low and there is extreme cold, ice blockage renders navigation "extremely dangerous."

During winter and spring, the ice creates additional navigational problems by dragging the buoys off-station and destroying shore aids. The extent of this damage varies with the severity of the winter conditions but usually affects not less than 1/3 of the buoys. District-wide the Coast Guard replaces 60 percent of its buoys each year due to losses from ice and other causes.

(g) Regulatory and/or Legal Constraints

Certain regulations, especially those involved in the permit process, regulatory agencies and groups, and other issues present constraints to river related economic development in the GREAT III study area. These regulations, agencies and groups have already been discussed in detail in Chapter IV which presented the analysis of the case study developments and in Appendix A. In summary, the most problematical or potentially problematical regulations include:

- Section 404 of Clean Water Act.
- Section 401 of Clean Water Act.
- Section 10 of River and Harbor Act of 1899.
- Endangered Species Act.
- National Environmental Policy Act.
- Floodplain Regulations.
- Air Quality Act.
- Illinois' Fleeting Permit Requirements.
- Illinois' Rivers, Lakes and Streams Act of 1911.
- Various Zoning Laws.

These regulations can cause significant delays and additional inflationary and compliance costs thereby constraining or even discouraging river-related industrial development.

VI - CATEGORIZATION OF AVAILABLE LAND

OBJECTIVE AND METHODOLOGY

This section of the report identifies those vacant lands adjacent to the Mississippi River for potential river-related industrial and/or terminal development. To identify these locations the following, studies were first reviewed:

- "Industrial Site and Building Survey," for Southwest Regional Port District by Southwestern Illinois Metropolitan and Regional Planning Commission (SIMAPC);
- Industrial Port Site Survey," by SIMAPC;
- "Riverfront Industrial Development Potential for Locations along the Mississippi River: Lewis, Marion, Ralls, and Pike Counties, Missouri," by Mark Twain Regional Advisory Commission;
- "Study of the Port of Metropolitan St. Louis, Appendix I; by A. T. Kearney, Inc., and East-West Gateway Coordinating Council; and
- "Opportunities for River-Related Industrial Development in the Port of Metropolitan St. Louis," for the First National Bank in St. Louis by Sverdrup Corporation.

Other locations were identified using the "Industrial Location Selection Criteria" in conjunction with in-house color-coded land use maps. Exhibit VI-1 contains the location selection criteria used to determine areas compatible for industrial development. Table VI-1 briefly outlines these criteria.

Table VI-1

Industrial Location Selection Criteria

1. Flood protection.
2. Distance to the shore.
3. Availability of other transportation.
4. Topography.
5. Environmental.
6. Social.
7. Utilities.
8. Distance from shore to channel.
9. Loss of Agricultural land.

Source: Exhibit VI-1.

Once identified, locations were ranked according to relative development potential (by scoring the location selection criteria). Locations scored as "1" were considered to have good potential with little improvement costs required and/or minimal environmental problems. Those locations scored as "2" were considered land with good potential but major improvement costs and/or major environmental problems. The remaining tracts considered to have little or no development potential were scored as "3". This ranking was accomplished by scoring each selection criteria according to a similar scheme as noted in the Exhibit VI-1 and then taking the average of the criteria score for each location. An average criteria score of less than 1.5 was classified as a "1" and an average score of 1.5 and above was classified as a "2".

In addition to the above ranking scheme, typical requirements of the types of terminals that need to be brought on line were necessary input for identifying potential port locations.

These needs used in the analysis are provided below by type of facility:

1. <u>Grain Terminal</u>

   Size - Approximately 15 to 20 acres plus rail yard of 10 to 15 acres.
   Storage Facilities - Probably silos, although covered storage has been used.
   Intermodal Transportation - Both road and rail desirable, with dumping facilities and scales.
   Utilities - Electric, domestic water and sewer.
   Minor office facilities.
   Handling Facilities - Conveyor systems.

2. <u>Steel Terminal</u>

   Size - Approximately 15 to 20 acres.
   Storage Facilities - Warehouses and open storage, depending on quantity and type of actual commodities.
   Intermodal Transportation - Both road and rail desirable.
   Utilities - Electric, domestic water and sewer.
   Minor office facilities.
   Handling Facilities - Cranes, heavy fork lifts, etc.

3. Chemical Terminal

   Size - Approximately 15 to 20 acres.
   Storage Facilities - Probably a tank farm.
   Intermodal Transportation - Road mostly, rail very questionable.
   Utilities - Electric, domestic water and sewer.
   Minor office facilities.
   Handling Facilities - Most commodities would probably be pumped.

4. Coal Terminal

   Size - Approximately 120 acres.
   Storage Facilities - On-site stockpiling with stacker reclaimer.
   Intermodal Transportation - Rail loop unit train; car dumping facility.
   Minor office facilities.
   Handling Facilities - Conveyor systems, barge berthing facility.

The criteria used are fully described in Exhibit VI-1. The location selection criteria most important to these types of facilities and which were focused on are the following:

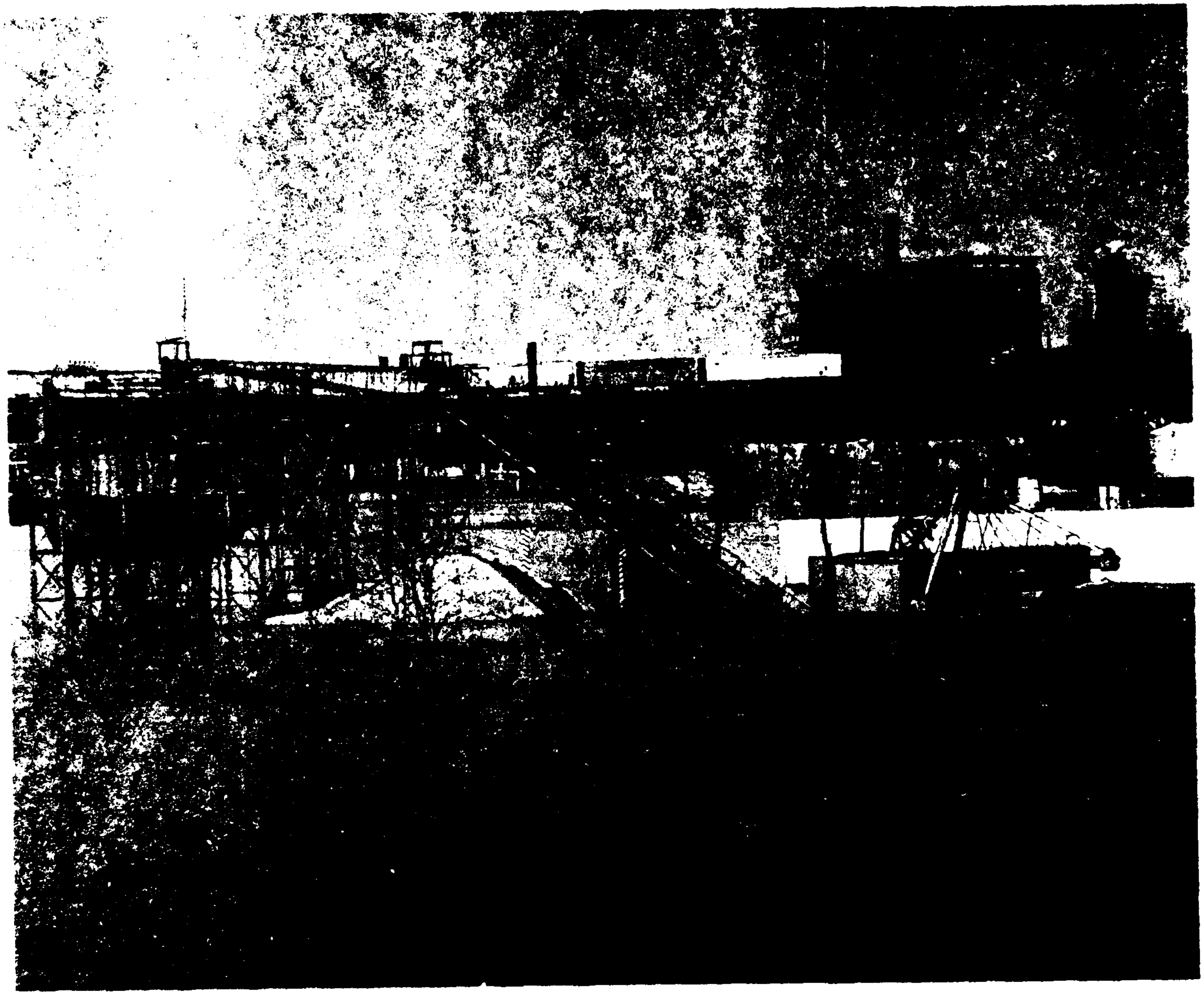
1. Flood (Protection) Hazard - Grain and chemical terminals could easily convey commodities over flood-prone areas subject to environmental restrictions. The conveyance could extend to 1/2 mile if necessary without being cost prohibitive.

2. Distance to River Channel - All terminal types would prefer to be as close as possible without interfering with normal river traffic. Also, areas where shoaling is a constant problem are undesirable.

3. Topography - Site preparation costs (grading, etc.) should be considered. Economy dictates that a site should be above the 100 year floodplain.

4. Availability of Intermodal Transportation - Access to other modes is essential.

5. Improvement Cost - Developers can expect to spend $2 to $5 million on a new terminal depending on use and size.



A prime consideration for industrial development is its susceptability to flooding. Note floodwall protection of tanks and warehouses in the background.

Order-of-magnitude unit costs were developed utilizing recently completed industrial development projects with 1981 construction costs. These projects average 1,300 gross acres with a development cost of $22,185 per gross acre. Since costs were generated in mid 1981, to account for inflation $23,000 per gross acre was used for development costs. This figure does not include raw land cost, flood protection costs such as levees or pump stations, or major extensions of roads, railroads, or utilities beyond approximately 1,000 feet. Locations requiring these improvements were designated as such. Costs included in the $23,000 per gross acre figure are basic infrastructure costs - roads, utilities, railroad spurs, and flood protection.

While simple proximity to railroad transportation was used as a screening criterion for this analysis, it must be emphasized that the specific railroad company involved should be considered in the actual site selection process for any river oriented facility. Firms desiring to establish a facility must fully understand the markets they expect to serve and evaluate the willingness of specific rail carriers to collaborate to the degree necessary before committing resources. This can only be done on a case by case basis and such analysis was not executed in this study. Nevertheless, the issue is important enough to merit a warning that the rail access criterion employed here was solely for screeing purposes. A more thorough analysis of rail access would be necessary for actual siting decisions, as would be an analysis of other issues.

RESULTS OF CATEGORIZATION

A preliminary effort to identify potential industrial locations found 136 locations. Upon ranking the locations according to the location selection criteria, 34 most desirable locations and 102 additional locations with less than desirable characteristics were identified. While many of the 34 most desirable locations have some constraints, they represent those with the best potential for river-related industrial development. The most significant location constraints are noted on the lists for the 34 most desirable locations and the other 102 locations. These lists are contained in Exhibit VI-2 and Exhibit VI-3 which follow. Also, a map depicting the locations of the 34 most desirable locations is found in Figure VI-1 on the following page. More detailed color-coded land use maps with overlays showing all 136 potential locations are contained in a separately bound appendix (Appendix B). An example of the detail provided by the maps contained in Appendix B is shown by the map in Figure VI-2.

Great River Resource Management Study Area

GREAT III

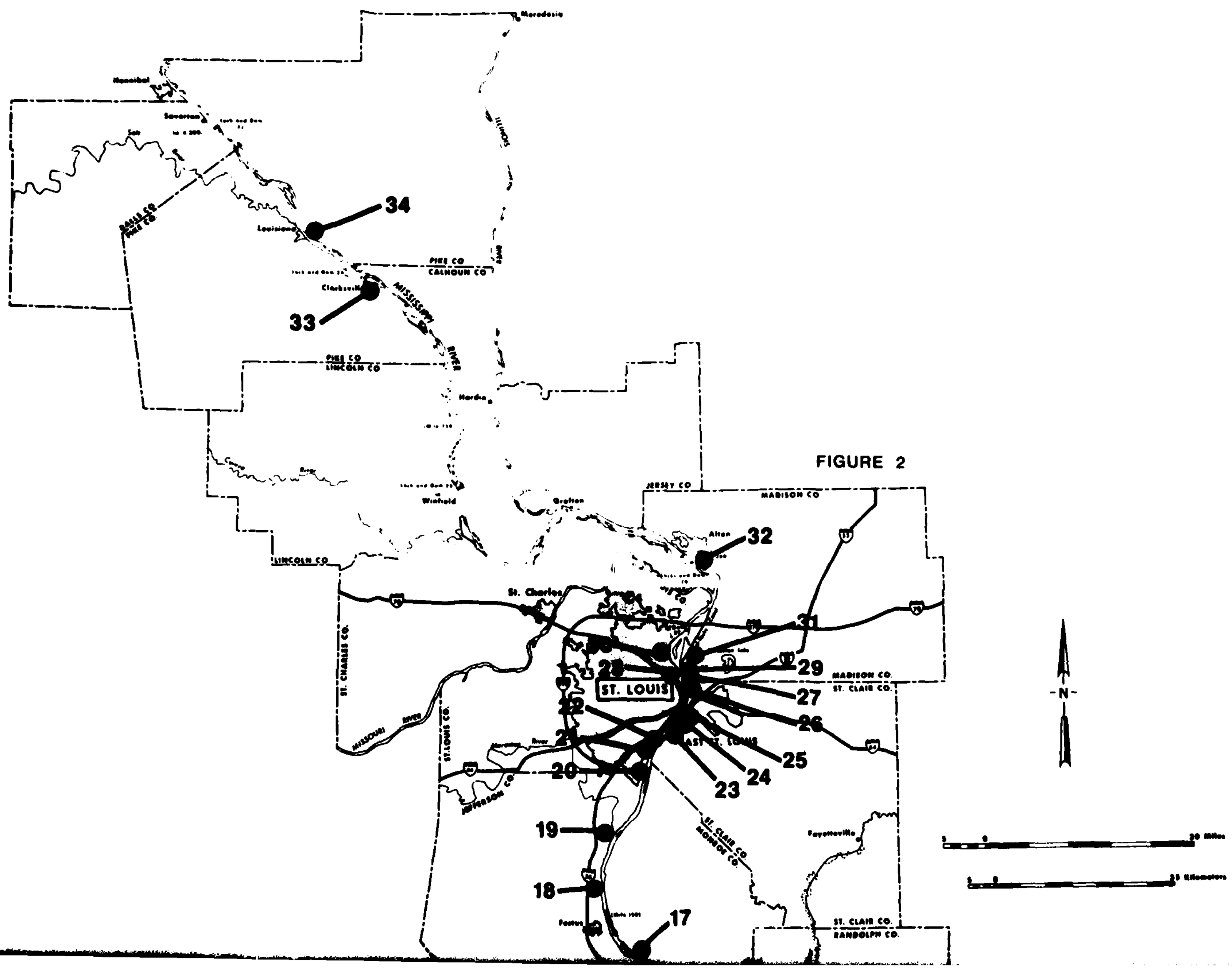
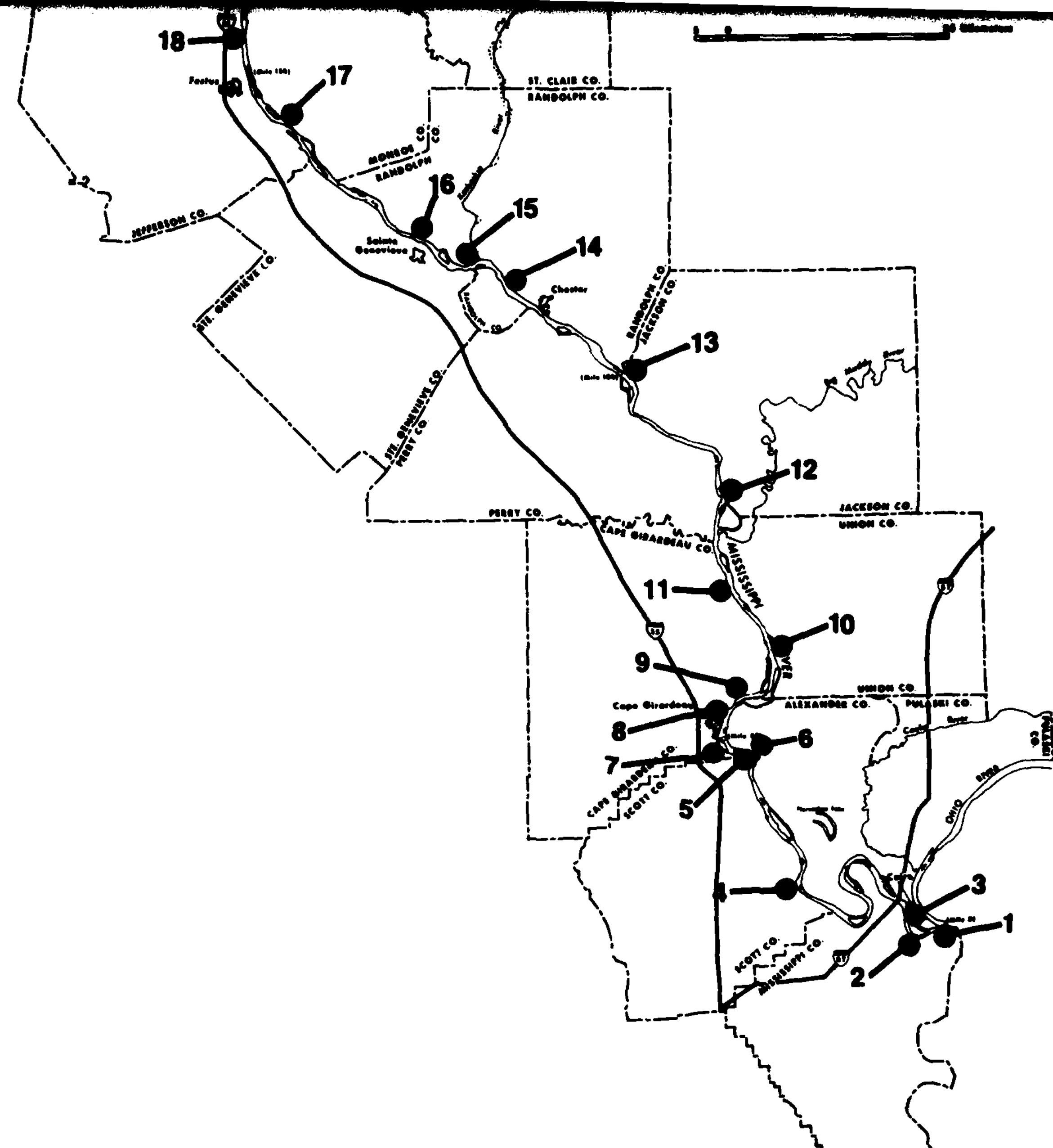


FIGURE 2

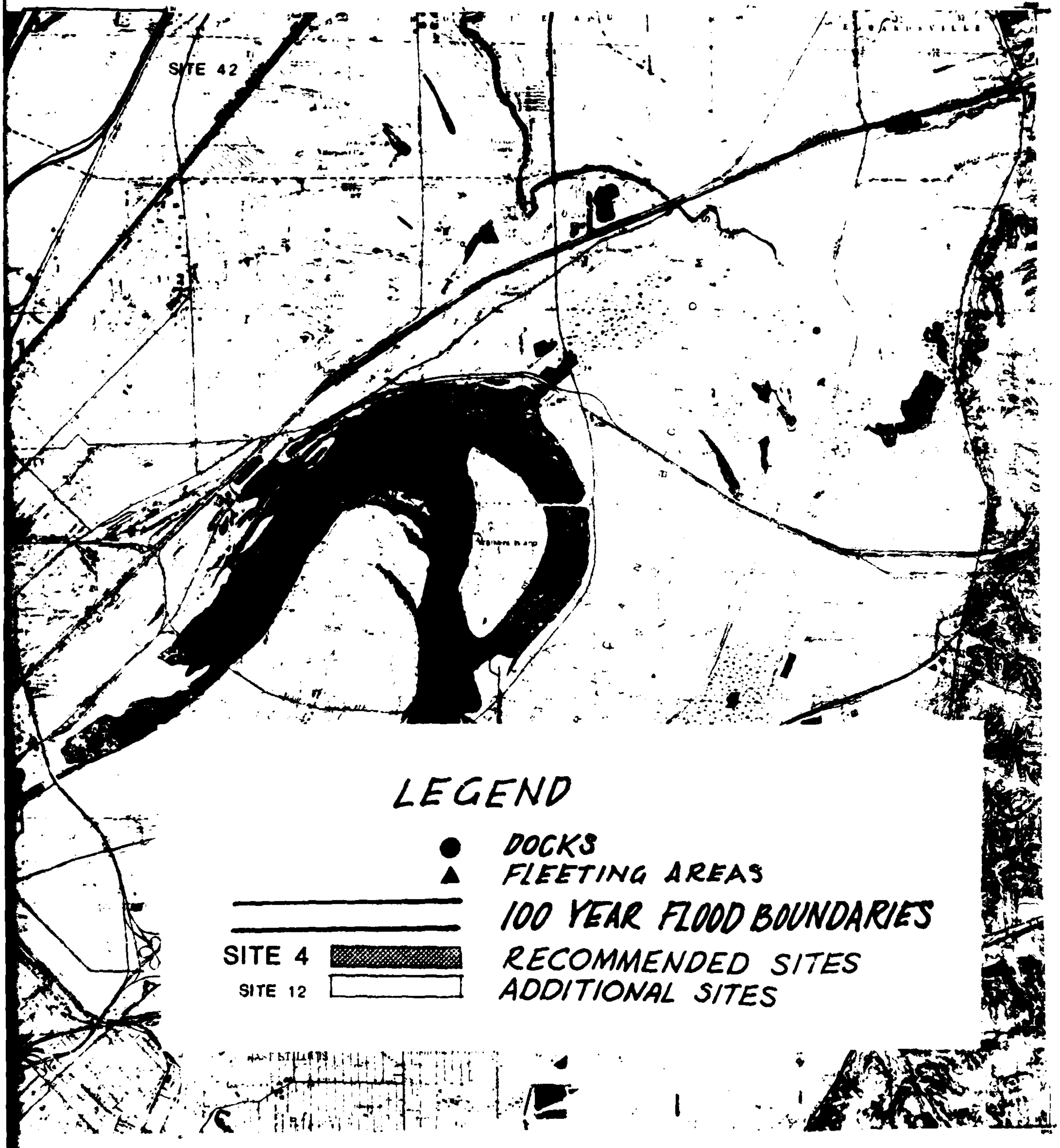


AVAILABLE RECOMMENDED INDUSTRIAL LAND IN THE GREAT III AREA

MIDDLE MISSISSIPPI RIVER
(MILE 180 TO MILE 189)

Note: This map was reproduced from color-coded land use maps.

MIDDLE MISSISSIPPI RIVER
(MILE 180 TO MILE 189)



MIDDLE MISSISSIPPI RIVER
MILE 180 TO 189

Sverdrup

PLATE 12

oded land use maps.

2

GROWTH TREND INTERVIEWS

In order to document anticipated industry growth and provisions to accommodate this growth, interviews were conducted with port authorities, local development associations, chamber of commerces, banks, and construction firms. Nine interviews were conducted with port authorities - four in Illinois and 5 in Missouri - while 16 interviews were conducted with the other parties.

(a) Interview Findings

Basically, these informal interviews served to support the categorization of lands and checked anticipated industrial development, both river-related and non-river related. Important highlights include:

1. An adequate amount of land is available for river-related and non-river related industrial development.

2. A sufficient labor force with a good skill mix is available.

3. Job intensive industries are considered desirable for new developments.

4. Grain, coal, and chemical firms, in particular, have expressed an interest in locating in the GREAT III area.

5. Most locations will require major improvements.

GREAT III
INDUSTRIAL LOCATION SELECTION CRITERIA

A. Flood protection: 1 = outside the 100-year floodplain; 2 = within the 100-year floodplain or in 100-year floodplain fringe.

B. Distance to normal river channel: 1 = less than 0.25 mile; 2 = 0.25 mile or greater.

C. Availability of non-river transportation: 1 = less than 0.25 mile to either highway or rail; 2 = 0.25 mile or greater to highway or rail.

D. Topography (on site): 1 = less than 50 feet of vertical displacement on the site; 2 = 50 feet or greater of vertical displacement on the site.

E. Topography (off site): 1 = 0-50 feet of vertical rise from river to site; 2 = more than 50 feet vertical rise from river to site.

F. Environmental: 1 = no environmentally sensitive areas on site; 2 = environmentally sensitive areas on or immediately adjacent to site.

G. Social: 1 = 0.25 mile or greater from any residential area, school, or park; 2 = less than 0.25 mile from any residential area, school, or park.

H. Utilities: 1 = water, sewer and electrical available on site or immediately adjacent; 2 = water, sewer and electrical more than 0.25 mile from site.

I. Proximity to river channel: 1 = channel is adjacent to bank on the site-side of the river (minimum dredging); 2 = channel is opposite the site-side of the river (maximum dredging).

J. Loss of agricultural land 1 = less than 50% of the site is prime agricultural land; 2 = 50% or greater prime agricultural land on the site.

ANALYSIS OF MOST DESIRABLE INDUSTRIAL LAND IN THE GREAT III AREA

Site Number	River Mile	County/State	Size In Acres	Order-of-Magnitude On-Site Development Cost	Constraints	Order-Of-Magnitude Off-Site Development Cost*	Plate Number**
1.	0.2- 2.0	Mississippi/MO	323	$ 7,429,000	More than 0.25 mile from river; no rail service; requires utilities; prime agricultural land	Rail - $6,000,000 Water & Sewer - $3,945,000	1.
2.	2.5- 4.5	Mississippi/MO	448	$10,304,000	No rail service; requires utilities; prime agricultural land	Rail - $4,800,000 Water & Sewer - $7,740,000	1.
3.	5.2- 6.2	Alexander/IL	117	$ 2,691,000	Adjacent to city park and residential area	--	1.
4.	29.2-31.2	Scott/MO	268	$ 6,164,000	No rail service; requires utilities; prime agricultural land	Rail - $4,200,000 Water & Sewer - $4,560,000	2.
5.	44.3-44.6	Scott/MO	59	$ 1,357,000	Rail service about 0.5 mile away; requires utilities; prime agricultural land	Rail - $420,000 Water & Sewer - $1,590,000	3.
6.	46.0-46.5	Alexander/IL	55	$ 1,265,000	Within the 100-year floodplain; rail service and highway are about 0.25 mile away; requires utilities; prime agricultural land	Road - $449,000 Rail - $360,000 Flood Protection - See Note 1 Water & Sewer - $1,050,000	3.
7.	47.5-48.0	Cape Girardeau/MO	305	$ 7,015,000	Land presently being developed	--	3.
8.	53.0-54.0	Cape Girardeau/MO	77	$ 1,771,000	Within the 100-year floodplain; prime agricultural land	Flood Protection - $4,200,000	3.
9.	54.8-55.3	Cape Girardeau/MO	110	$ 2,530,000	Prime agricultural land	--	3.
10.	60.2-61.2	Union/IL	566	$13,018,000	More than 0.25 mile from river; within the 100-year floodplain; requires utilities; prime agricultural land	Flood Protection - $24,300,000 Water & Sewer - $9,000,000	3.
11.	69.5-69.8	Cape Girardeau/MO	40	$ 920,000	Requires utilities; prime agricultural land	Water & Sewer - $300,000	4.

ANALYSIS OF MOST DESIRABLE INDUSTRIAL LAND IN THE GREAT III AREA

Site Number	River Mile	County/State	Size In Acres	Order-of-Magnitude On-Site Development Cost	Constraints	Order-Of-Magnitude Off-Site Development Cost*	Plate Number**
12.	80.0- 80.6	Jackson/IL	80	$ 1,840,000	Within the 100-year floodplain; requires utilities; prime agricultural land	Flood Protection - See Note 2 Water & Sewer - $300,000	5.
13.	97.0- 98.4	Jackson/IL	874	$20,102,000	Within the 100-year floodplain; requires utilities; prime agricultural land	Flood Protection - $24,900,000 Water & Sewer - $6,383,000	6.
14.	111.5-114.5	Randolph/IL	588	$13,524,000	Within the 100-year floodplain; requires utilities; river channel is opposite to site; prime agricultural land	Flood Protection - $17,600,000 Water & Sewer - $9,480,000	7.
15.	118.0-118.5	Randolph/IL	540	$12,420,000	Within the 100-year floodplain; requires utilities; prime agricultural land	Flood Protection - $2,900,000 See Note 3 Water & Sewer - $8,475,000	7.
16.	124.8-125.2	Randolph/IL	125	$ 2,875,000	More than 0.25 mile from river; within the 100-year floodplain; requires utilities; prime agricultural land	Flood Protection - See Note 1 Water & Sewer - $2,550,000	8.
17.	142.0-142.3	Monroe/IL	136	$ 3,128,000	Within the 100-year floodplain; railroad service about 1.5 miles away; utilities required; prime agricultural land	Rail - $1,200,000 Flood Protection - See Note 1 Water & Sewer - $2,550,000	9.
18.	153.3-153.5	Jefferson/MO	51	$ 1,173,000	More than a 50-foot variation in topography on site; adjacent to residential area	--	10.
19.	159.0-161.2	Jefferson/MO	320	$7,360,000	Within the 100-year floodplain; no highway access; requires utilities; prime agricultural land	Road - $1,795,000 Flood Protection - $6,300,000 Water & Sewer - $5,085,000	10.

ANALYSIS OF MOST DESIRABLE INDUSTRIAL LAND IN THE GREAT III AREA

Site Number	River Mile	County/State	Size In Acres	Order-of-Magnitude On-Site Development Cost	Constraints	Order-Of-Magnitude Off-Site Development Cost*	Plate Number**
20.	169.0-169.5	St. Louis/MO	55	$ 1,265,000	More than 50-foot variation in topography on site; adjacent to residential area; site already partially developed	--	10.
21.	171.3-177.7	St. Louis/MO	92	$ 2,116,000	Within the 100-year floodplain; adjacent to residential areas	Flood Protection - $6,900,000	11.
22.	172.5-173.3	St. Louis/MO	158	$ 3,634,000	A portion of the site is within the 100-year floodplain; adjacent to residential areas	Flood Protection - $2,300,000	11.
23.	175.6-177.2	St. Clair/IL	643	$14,789,000	Within the 100-year floodplain	Flood Protection - $17,300,000	11.
24.	177.2-178.0	St. Clair/IL	356	$ 8,188,000	Within the 100-year floodplain	Flood Protection - $9,500,000	11.
25.	178.0-178.9	St. Clair/IL	213	$ 4,899,000	Within the 100-year floodplain	Flood Protection - $6,600,000	11.
26.	180.2-180.9	Madison/IL	268	$ 6,164,000	No obvious constraints	--	12.
27.	180.9-181.9	Madison/IL	162	$ 3,726,000	No obvious constraints	--	12.
28.	183.8-184.1	St. Louis/MO	55	$ 1,265,000	No obvious constraints	--	12.
29.	183.6-184.3	Madison/IL	121	$ 2,783,000	Within the 100-year floodplain; adjacent to residential area	Flood Protection - $6,500,000	12.
30.	185.7-187.3	St. Louis/MO	573	$13,179,000	Portion of site within the 100-year floodplain; adjacent to some residences	Flood Protection - $9,000,000	12.
31.	Chain of Rocks Canal	Madison/IL	488	$11,224,000	Government property	--	12.

ANALYSIS OF MOST DESIRABLE INDUSTRIAL LAND IN THE GREAT III AREA

Site Number	River Mile	County/State	Size In Acres	Order-of-Magnitude On-Site Development Cost	Constraints	Order-Of-Magnitude Off-Site Development Cost*	Plate Number**
32.	198.0-203.0	Madison/IL	1,829	$42,067,000	Portion of site within the 100-year floodplain; adjacent to residential area.	Flood Protection - $31,400,000	13-14
33.	270.8-271.8	Pike/MO	540	$12,420,000	Within the 100-year floodplain; requires utilities; prime agricultural land	Flood Protection - $6,700,000 Water & Sewer - $8,475,000	19.
34.	282.0-283.0	Pike/IL	231	$ 5,313,000	Within the 100-year floodplain; adjacent to residential area; requires utilities; primary river channel is opposite to site; prime agricultural land	Flood Protection - $5,600,000 Water & Sewer - $4,065,000	20.

* Includes no contingencies.

** Plate numbers refer to maps contained in Appendix B.

Notes: (1) Conflicting information on the degree of flood protection. If protection is required, cost would be as follows: Site 6 - $5,700,000; Site 16 - $5,900,000; and Site 17 - $11,600,000.

(2) Site uses one foot of available three feet of freeboard for adequate protection.

(3) Cost shown is minimum for Site 15. Because of inadequate data, cannot determine if additional protection is required at an additional cost of $16,300,000.

ADDITIONAL SITES REVIEWED FOR INDUSTRIAL DEVELOPMENT SUITABILITY IN THE GREAT III AREA

Site Number	River Mile	County/State	Site Constraints	Plate* Number
1	1.5-2.5	Alexander/IL	Within the floodway; no rail service; river channel is opposite to site; prime agricultural land; requires utilities	1
2	13.5-13.5	Alexander/IL	Within 100-year floodplain; prime agricultural land; requires utilities	1
3	23.0-24.0	Mississippi/MO	No rail service; no immediate road connection; requires utilities; prime agricultural land	1
4	39.0-39.5	Scott/MO	No rail service; adjacent residential areas; river channel is opposite to site; prime agricultural areas	2
5	39.5-39.8	Alexander/IL	No highway access; more than 0.25 mile from river; near wildlife conservation area; channel is opposite to site; prime agricultural areas	2
6	39.8-40.2	Scott/MO	Within the 100-year floodplain; floodway constriction; prime agricultural land; no rail service	2
7	42.8-43.2	Scott/MO	No highway access; channel is opposite to site; requires utilities; no rail service	2-3
8	54.0-54.3	Cape Girardeau/MO	On-site topography has greater than 50 feet of vertical displacement; more than 50 feet above floodplain; adjacent to residential areas	3

ADDITIONAL SITES REVIEWED FOR INDUSTRIAL DEVELOPMENT SUITABILITY IN THE GREAT III AREA (Cont'd.)

Site Number	River Mile	County/State	Site Constraints	Plate* Number
9	60.0-60.2	Union/IL	More than 0.25 mile to river channel; requires utilities; prime agricultural land	3
10	66.6-66.9	Cape Girardeau/MO	No highway access; conflicts with recreational port at site; on-site topography has greater than 50 feet of vertical displacement; no highway access; requires utilities prime agricultural land	4
11	72.0-72.6	Cape Girardeau/MO	On-site topography has more than 50 feet of vertical displacement; no highway access; requires utilities	4
12	72.9-73.1	Cape Girardeau/MO	On-site topography has more than 50 feet of vertical displacement; no highway access; requires utilities; prime agricultural land	4
13	75.3-75.6	Perry/MO	No highway access; requires utilities; prime agricultural land	4
14	81.8-83.3	Perry/MO	Within the 100-year floodplain; floodway constriction; utilities required; prime agricultural land	5
15	99.7-101.3	Randolph/IL	Within the 100-year floodplain; river channel is opposite to site; utilities required	6
16	101.5-101.8	Perry/MO	Within the 100-year floodplain; no rail service; requires utilities; prime agricultural land	6
17	106.7-107.0	Randolph/IL	More than 0.25 mile from river; requires uilities; prime agricultural land	7
18	108.8-109.4	Perry/MO	Within the 100-year floodplain; no rail service; require utilities; prime agricultural land	7

ADDITIONAL SITES REVIEWED FOR INDUSTRIAL DEVELOPMENT SUITABILITY IN THE GREAT III AREA (Cont'd.)

Site Number	River Mile	County/State	Site Constraints	Plate* Number
19	115.0-115.2	Randolph/IL	Within the 100-year floodplain; no rail service; requires utilities; prime agricultural land	7
20	126.0-126.5	Ste. Genevieve/MO	On-site topography more than 50 feet of vertical displacement; offsite topography more than 50 feet above floodplain; no highway access; requires utilities; prime agricultural land	8
21	128.8-129.1	Ste. Genevieve/MO	No highway access; requires utilities; prime agricultural land	8
22	131.1-131.7	Randolph/IL	Within the 100-year floodplain; no rail service; requires utilities; prime agricultural land	8
23	148.5-149.5	Jefferson/MO	Within the 100-year floodplain; channel is opposite to site; adjacent to residential areas; prime agricultrual land	9
24	150.8-151.8	Jefferson/MO	On-site topography is greater than 50 feet of vertical displacement on site; off-site topography is greater than 50 feet above the floodplain; requires utilities; adjacent to recreational and residential areas	9-10
25	153.8-154.6	Monroe/IL	Within the 100-year floodplain; more than 0.25 mile to river channel; requires utilities; prime agricultural land	10
26	156.6-156.7	Jefferson/MO	Within the 100-year floodplain; on-site topography is greater than 50 feet of vertical displacement; off-site topography is greater than 50 feet above the floodplain; small size; no highway access; adjacent to recreational area	10

ADDITIONAL SITES REVIEWED FOR INDUSTRIAL DEVELOPMENT SUITABILITY IN THE GREAT III AREA (Cont'd.)

Site Number	River Mile	County/State	Site Constraints	Plate* Number
27	160.2-162.0	Monroe/IL	Within the 100-year floodplain; more than 0.25 mile form the river channel; no rail service; requires utilities; prime agricultural land	10
28	161.0-161.8	St. Louis/MO	Within the 100-year floodplain; no roads; requires utilities	10
29	163.0-164.5	Monroe/IL	Within the 100-year floodplain; more than 0.25 mile to river channel; requires utilities; prime agricultural land	10
30	164.8-165.6	Monroe/IL	Within the 100-year floodplain; more than 0.25 mile from the river channel; no rail service; requires utilities; prime agricultural land	10
31	166.0-168.9	Monroe/IL	Within the 100-year floodplain; requires utilities; more than 0.25 mile from river channel; prime agricultural land	10
32	170.0-172.0	Monroe-St. Clair/IL	Within the 100-year floodplain; requires utilities; adjacent to residential areas; prime agricul-tural land	11
33	172.0-173.5	St. Clair/IL	Within the 100-year floodplain; portion of site too distant from river; prime agricultural land	11
34	174.0-175.5	St. Clair/IL	Within the 100-year floodplain; no highway access; channel is opposite to site; utilities required; prime agricultural land	11
35	179.1-179.3	St. Clair/IL	Within the 100-year floodplain; conflicting and competing plans for its use	11
36	179.5-179.6	St. Clair/IL	Conflicting and competing plans for its use	11

ADDITIONAL SITES REVIEWED FOR INDUSTRIAL DEVELOPMENT SUITABILITY IN THE GREAT III AREA (Cont'd.)

Site Number	River Mile	County/State	Site Constraints	Plate* Number
37	182.0-182.2	St. Louis City/MO	Within the 100-year floodplain	12
38	182.0-182.2	St. Clair-Madison/IL	More than 0.5 mile from the river channel; adjacent to residential areas	12
39	183.0-183.3	Madison/IL	More than 0.25 mile from the river channel; adjacent to residential areas	12
40	183.3-184.5	Madison/IL	Government ownership	12
41	Chain of Rocks Canal	Madison/IL	A portion of the site is within the 100-year floodplain; government ownership	12
42	Chain of Rocks Canal	Madison/IL	Government ownership; a portion of the site is within the 100-year floodplain; prime agricultural land	12-13
43	187.3-187.6	St. Louis City/MO	Within the 100-year floodplain; river locked	12
44	187.8-189.8	St. Louis City/MO	Within the 100-year floodplain; river locked	12-13
45	190.4-191.3	St. Louis City/MO	Within the 100-year floodplain; on-site topography greater than 50 feet vertical displacement; no rail service	13
46	191.5-193.8	St. Louis/MO	Within the 100-year floodplain; utilities required; prime agricultural land; no rail service	13
47	192.6-194.9	Madison/IL	Within the 100-year floodplain; adjacent residential areas; includes state park; government ownership	13
48	195.0-195.8	Madison/IL	Within the 100-year floodplain	13
49	195.0-196.2	Madison/IL	A portion of site is within the 100-year floodplain; most of the site is more than 0.25 mile from river channel; prime agricultural land	13

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ADDITIONAL SITES REVIEWED FOR INDUSTRIAL
DEVELOPMENT SUITABILITY IN THE GREAT III AREA (Cont'd.)

Site Number	River Mile	County/State	Site Constraints	Plate* Number
50	196.2-196.3	Madison/IL	Within the 100-year floodplain; adjacnet to residential area	13
51	209.0-210.0	Jersey/IL	Within the 100-year floodplain; channel is opposite site; golf course, residential and boat ramp are on site; requires utilities; no rail service	14
52	210.0-211.3	St. Charles/MO	Within the 100-year floodplain; park and residential areas; utilities required; prime agricultural land; government ownership of riverfront	14
53	216.8-217.0	Jersey/IL	Portion of site is within the 100-year floodplain; adjacent to residential areas; on-site topography is greater than 50 feet vertical displacement; no rail service	14
54	217.6-217.8	Jersey/IL	Within the 100-year floodplain; adjacent to residential areas; on-site topography is greater than 50 feet vertical dispalcement; no rail service	15
55	244.0-244.5	Calhoun/IL	Portion of the site is within the 100-year floodplain; utilities required; prime agricultural land; no rail service	15
56	224.8-255.0	Calhoun/IL	Within the 100-year floodplain; no rail service or highway access	15
57	226.2-226.3	Calhoun/IL	Within the 100-year floodplain; no rail service or highway access	15
58	231.6-231.7	Calhoun/IL	Within the 100-year floodplain; no rail service or highway access; river channel is opposite to site	15

ADDITIONAL SITES REVIEWED FOR INDUSTRIAL
DEVELOPMENT SUITABILITY IN THE GREAT III AREA (Cont'd.)

Site Number	River Mile	County/State	Site Constraints	Plate* Number
59	234.2-234.6	Calhoun/IL	On-site topography is greater than 50 feet vertical displacement; off-site topography is more than 50 feet above floodplain; no road or rail access; utilities required	16
60	237.4-237.6	Calhoun/IL	On-site topography is greater than 50 feet of vertical displacement; off-site topography is more than 50 feet above floodplain; no rail service; requires utilities	16
61	237.6-237.9	Calhoun/IL	Within the 100-year floodplain; small site; no rail service or highway access; requires utilities	16
62	238.6-238.7	Calhoun/IL	Within the 100-year floodplain; small site; no rail service or highway access; requires utilities	16
63	239.6-239.8	Calhoun/IL	Within the 100-year floodplain; small site; no rail service or highway access; requires utilities	16
64	239.0-240.6	Lincoln/MO	Adjacent to residential areas; utilities required; no rail service; portion of site is swamp	16
65	240.7-241.3	Calhoun/IL	Within the 100-year floodplains; impacts on park; utilities required; no rail service; government ownership	16
66	241.0-242.3	Calhoun/IL	On-site topography is greater than 50 feet of vertical displacement; off-site topography is more than 50 feet above floodplain; no rail service; utilities required	16

ADDITIONAL SITES REVIEWED FOR INDUSTRIAL DEVELOPMENT SUITABILITY IN THE GREAT III AREA (Cont'd.)

Site Number	River Mile	County/State	Site Constraints	Plate* Number
67	242.3-242.5	Calhoun/IL	Within the 100-year floodplain; no rail service or highway access; small wetland; adjacent to residential areas; utilities required; park/recreation along riverfront	17
68	242.3-242.6	Calhoun/IL	Wetland area; within the 100-year floodplain; conservation, park/recreation and government ownership of riverfront	17
69	244.0-244.5	Calhoun/IL	Adjacent to wildlife management area; topography constraints; no rail service; requires utilities	17
70	246.5-246.8	Calhoun/IL	Within wildlife management area; off-site topography is more than 50 feet above floodplain; no rail service; requires utilities	17
71	247.0-248.8	Calhoun/IL	Within wildlife management area; within 100-year floodplain; utilities required; no rail service	17
72	249.-250.5	Calhoun/IL	Within wildlife management area; within 100-year floodplain; utilities required; no rail service; river channel more than 0.25 miles	17
73	249.5-250.0	Lincoln/MO	Within wildlife management area; within 100-year floodplain; utilities required; no rail service	17
74	250.5-251.0	Lincoln/MO	Within wildlife management area; within 100-year floodplain; utilities required; no rail service	17-18

ADDITIONAL SITES REVIEWED FOR INDUSTRIAL DEVELOPMENT SUITABILITY IN THE GREAT III AREA (Cont'd.)

Site Number	River Mile	County/State	Site Constraints	Plate* Number
75	251.8-253.8	Lincoln/MO	Within wildlife management area; within 100-year floodplain; utilities required; no rail service; prime agricultural land; more than 0.25 mile to river channel	18
76	253.8-255.0	Lincoln/MO	Within wildlife management area; within 100-year floodplain; utilities required; prime agricultural land; more than 0.25 mile to river channel; no rail service	18
77	255.3-256.5	Calhoun/IL	Within wildlife management area; within 100-year floodplain; utilities required; no rail service; prime agricultural land	18
78	257.4-258.3	Calhoun/IL	Within the 100-year floodplain; adjacent to residential areas; prime agricultural land; no rail service; utilities required	18
79	239.3-259.6	Calhoun/IL	Within the 100-year floodplain; adjacent to residential and campground areas; utilities required; no rail service	18
80	259.0-259.8	Pike/MO	Within the 100-year floodplain; wildlife refuge adjacent to site; more than 0.25 mile river; utilities required; no rail service	18
81	260.0-260.4	Calhoun/IL	Within the 100-year floodplain; adjacent to residential and recreational areas; no rail service; utilities required	19
82	261.0-262.0	Pike/MO	Within the 100-year floodplain; wildlife refuge area adjacent to site; more than 0.25 mile to river; no rail service; prime agricultural land	19

ADDITIONAL SITES REVIEWED FOR INDUSTRIAL
DEVELOPMENT SUITABILITY IN THE GREAT III AREA (Cont'd.)

Site Number	River Mile	County/State	Site Constraints	Plate* Number
83	261.5-262.5	Calhoun/IL	Within the 100-year floodplain; wildlife refuge area adjacent to site; no rail service; utilities required	19
84	262.0-264.5	Pike/MO	Within a National Wildlife Refuge	19
85	265.0-267.3	Pike/MO	Adjacent to a National Wildlife Refuge; within the 100-year floodplain; requires utilities no railroad service or highway access; prime agricultural land	19
86	267.0-269.0	Calhoun/IL	Adjacent to a waterfowl management area; within the 100-year flood-plain; site is opposite river channel; requires utilities; no rail service; prime agricultural land	19
87	270.3-271.3	Calhoun/IL	Within the 100-year floodplain; no rail service or highway access; requires utilities; more than 0.25 mile to river channel; adjacent to conservation area	19
88	271.5-272.8	Calhoun/IL	Within the 100-year floodplain; no rail service or highway access; requires utilities; more than 0.25 mile to river channel; adjacent to conversation area	19
89	272.2-272.6	Pike/MO	Within the 100-year floodplain; prime agricultural land	19
90	274.1-274.6	Pike/MO	Portion of site within the 100-year floodplain; adjacent to state game refuge; river channel opposite site; portion of site is prime agricultural land	20

ADDITIONAL SITES REVIEWED FOR INDUSTRIAL DEVELOPMENT SUITABILITY IN THE GREAT III AREA (Cont'd.)

Site Number	River Mile	County/State	Site Constraints	Plate* Number
92	275.8-276.3	Pike/IL	Adjacent to wildlife management area; On-site topography more than 50 feet of vertical displacement; requires utilities	20
93	277.1-277.4	Pike/MO	On-site topography more than 50 feet of vertical displacement; wildlife management area is adjacent to site; requires utilities	20
94	278.0-281.8	Pike/IL	Within a National Wildlife Refuge	20
95	283.0-287.5	Pike/IL	Within the 100-year floodplain; requires utilities; no rail service or highway access; adjacent to park area	20
96	287.5-290.0	Pike/IL	Within the 100-year floodplain; wildlife area and wetlands are on the river side of site; no rail service or highway access; requires utilities; prime agricultural land	21
98	294.6-296.1	Pike/MO	Within the 100-year floodplain; wildlife area and wetlands are on the riverside of site; more than 0.25 mile from river channel; prime agricultural land	21
99	296.3-297.3	Pike/IL	Within the 100-year floodplain; no rail service or highway access; requires utilities; prime agricultural land; park/recreation along riverfront	21
100	296.8-297.9	Pike/IL	Within the 100-year floodplain; no rail service or highway access; requires utilities; prime agricultural land	21

ADDITIONAL SITES REVIEWED FOR INDUSTRIAL DEVELOPMENT SUITABILITY IN THE GREAT III AREA (Cont'd.)

Site Number	River Mile	County/State	Site Constraints	Plate* Number
101	297.7-298.6	Pike/MO	Within the 100-year floodplain; adjacent to wildlife management area; requires utilities; no highway access; prime agricultural land	21
102	299.2-300.5	Pike/MO	Within the 100-year floodplain; adjacent to wildlife management area; requires utilities; no highway access; prime agricultural land	21

* Plate number refers to maps contained in Appendix B.

VII - IMPACT ANALYSIS AND EVALUATION

This section of the report will assess the impact of failure to eliminate or mitigate the problems identified in the constraint analysis. The evaluation measures and the rationale for their selection are presented in a subsection below. The constraints and the associated evaluation measures are as follows:

- Locks - Tonnage not handled; risks associated with congestion.
- Channels - Risks associated with unsafe conditions.
- Bridges - Risks associated with bridges.
- Fleeting - Incremental cost.
- Terminals - Tonnage not handled; direct and indirect employment; tax base impact.

The impact analysis of fleeting and terminals are accorded separate treatment. Insofar as locks, channels, and bridges present similar safety hazards, they are grouped together for purposes of assessing the impacts of constraints associated with them. The impacts associated with fleeting and terminal constraints are quantifiable. However, locks, bridges, and channels pose safety issues which do not readily lend themselves to quantification. Therefore, for Great III study purposes these safety issues will be addressed in qualitative terms.

Safety issues are discussed with respect to vessel control accidents, accidents related directly to waterways system design or maintenance, or which stem from vessel control problems. As an overview before the discussion of the impacts of the various constraints, the causes and locations of vessel control accidents is discussed.

EVALUATION MEASURES SELECTED

In order to assess and evaluate the impact of the problems or constraints identified in this report it was necessary to develop appropriate as well as measurable evaluation measures. Table VII-1 presents the evaluation measures associated with the particular problem or constraint. These measures were jointly decided upon in discussions between A. T. Kearney and members of The Commercial Transportation Work Group and Industrial and Economic Development Work Group.

Table VII-1

Evaluation Measures

Problems or Constraints	Tonnage Not Handled	Incremental Cost	Employment Direct	Employment Indirect	Tax Base	Safety
Locks	X					X
Channels						X
Bridges						X
Fleeting		X				
Terminals	X		X	X	X	

The reasoning behind the selection of the respective measures is discussed below.

(a) Locks - Tonnage Not Handled, Safety Risks

The primary impact caused by a constraining lock, particularly Locks and Dam 26, is the tonnage that is not handled. This tonnage can be readily estimated. A secondary impact is the safety hazard posed by locks. Lock congestion increases the risk of casualties, spills and property damages. These risks will be greater given the projected increases in traffic volume. Although casualties, spills, and damages cannot be quantified, the risks associated with them due to locks are addressed.

(b) Channels - Safety Risks

Of the evaluation measures selected, the only ones pertinent to problems involving channel capacity (width and depth) are the safety measures. If channel hazards are not alleviated (addressed), increased traffic could exacerbate the safety hazard in high accident segments and points on the river. Hence, casualties, spills, and damages, to the extent they can be quantified, are appropriate impact assessment measures. Since these are not quantifiable in most cases, the risks associated with their occurrence are discussed.

A detailed printout of casualty records for the Upper Mississippi River was reviewed during the course of selecting safety related evaluation measures. Unfortunately, there was insufficient information to assign probabilities of accidents at specific sites. Without such probability estimates, the effects of dealng or not dealing with hazards cannot be quantified. Thus, a qualitative evaluation of problems was decided upon.

(c) Bridges - Safety Risks

Like channels, bridges pose safety hazards, and consequently the impacts of failing to address problem bridges must be evaluated by reference to the risk or probability of casualties, spills, and damages.

(d) Fleeting - Incremental Cost

The impact of a lack of available fleeting areas, or the prospect that they may have to be located some distance from the terminal is evaluated on the basis of the incremental cost involved in locating farther away from the terminal. Negligible impact would be found with respect to direct and indirect employment and the tax base, so that these impacts were ignored.

(e) Terminal Capacity - Tonnage Not Handled, Employment, and Tax Base Effect

The impact of failure to meet additional terminal capacity requirements is estimated by the amount of tonnage not handled, the number of jobs lost to the region, and the foregone increases to the tax base and resulting tax multiplier effects. These measures can be readily estimated.

SAFETY EVALUATION

(a) Overview of Vessel Control Accidents

Vessel control accidents based on U.S. Coast Guard (USCG) classifications consist of the following "casualty" types:

- Collisions between vessels: two or more moving vessels in a meeting, crossing, or overtaking situation [USCG categories 01, 02 and 03].
- Collisions while docking or undocking: two or more vessels [USCG category 5].
- Collisions with floating or submerged objects: objects other than ground, ice, or navigation aids [USCG category 8].
- Rammings: collisions with an anchored or moored vessel (if not docking/undocking); with a pier, bridge, lock or dam; or with a navigation aid [USCG categories 04, 09, and 11].
- Other collisions: collisions with a vessel in fog; with a vessel not otherwise classified (including minor bumps between vessel and tug); with ice; or with an object other than a vessel (e.g., offshore rigs, seaplanes) [USCG categories 06, 07, 10 and 12].
- Groundings with damage: over $1,500 damage to the vessel [USCG category 21].
- Groundings without damage: under $1,500 damage to the vessel [USCG category 22].

1. Causes of Vessel Control Accidents. Two recent studies by ORI, Inc. for the Coast Guard examined in detail records of collisions, rammings, and groundings for the fiscal years 1972 through 1976, with the objective of identifying consistent patterns of causal and situational factors. One study encompassed tows on all Western Rivers and the Gulf Intracoastal Waterway, excepting the Mississippi River below mile 125 because of dissimilarity in the traffic mix. The other study reviewed accidents in harbor areas involving either a tug/barge or a ship of greater than 10,000 gross registered tons.

Both studies concluded that collisions between vessels most often occur because at least one (and usually both) of the persons-in-charge fails to perform an essential task, typically the failure to establish bridge-to-bridge radio communication or otherwise signalling intentions. Failure to establish communication, when late detection of the other vessel was not a factor, was cited in 21 percent of the inland and 39 percent of the harbor collisions.

Failure to maintain position and late detection of the other vessel were the other major causal factors cited in both studies. Failure to maintain position is typically related to a misjudgment of the effects of wind and/or current, or by an inability to control vessel response in shallow waters or narrow channels. Both studies cited a high percentage of failure to use available equipment. The inland waterway study indicated that 31 percent of the vessels in collisions had their radios off or inoperable, while in the harbor study, 25 percent of the vessels had their radar off although apparently in working order.

Rammings and groundings were found in both studies to be similar in their primary causes: failure to maintain position against the effects of current and/or wind, miscalculation of vessel response, or failure to identify the hazard. Less common was failure to properly establish vessel position. Both reports note that vessel response against currents and wind effects in shallow waters and in narrow channels is not easily predictable and is not well understood. Equipment failures caused vessel control accidents in fewer than 10 percent of the cases examined in both studies.

2. Location of Vessel Control Accidents. Situational factors were also found to be very important in the ORI studies. The inland waterways study concluded that 86 percent of the vessel control accidents (collisions, rammings, and groundings) reported in fiscal years 1972 through 1976 occurred on just five waterways: the Upper Mississippi River, the Illinois Waterway, the Ohio River, the Lower Mississippi River above New Orleans, and the Gulf Intracoastal Waterway - West. These waterways accounted for about 75 percent of the total shallow-draft Gulf Coast and Mississippi River System ton-miles in 1977. Within these waterways, thirty-five 10-mile segments, comprising about 10 percent of the total navigable distance, accounted for 35 percent of all inland accidents involving a towboat or barge.

Even though the frequency of vessel control accidents tends to increase with higher levels of vessel traffic, there are situational factors which greatly increase the likelihood of a vessel control accident occurring. The inland segments where vessel control accidents most frequently occurred had these characteristics in common:

- One or more bridges.
- One or more locks.
- Bridges and locks.
- A bend or intersection with another channel.
- A very narrow available channel width.

Most of the high accident segments had more than one of these characteristics. For accidents at bridges and locks, 65 percent of the locations were also within one-half mile of a bend.

Eighty percent of the river accidents occurred on downriver passages, which reflects control problems when following the current. A tendency was noted for accidents at bridges to occur during high water periods. However, the data suggested that accidents increase during periods when the water level is changing. In particular, groundings do not notably increase during low water stages, but do increase during rapid, large stage changes, and are most common near bends or intersections with other waterways.

Another significant relationship noted was that collisions between vessels on inland waters often occurred at bends, at intersections, or in narrow channels. This was especially the case on the Gulf Intracoastal Waterway - West, which accounted for 45 percent of all collisions sampled. There was some evidence that a low ratio of tow width to available channel width was a factor in accidents at bridges, locks, bends, and in narrow channels. Accident case studies indicate a large number of failures in tow lashing gear leading to breakups, and a notable number of collisions and rammings (especially on the GIWW - West) occurring after tows have grounded.

(b) Impacts Associated with Locks, Channels, and Bridges in GREAT III Study Area

Locks, channels, and bridges can pose safety hazards which may well restrict barge traffic and/or increase the risk of accidents. Upon examination of data provided on safety, no deaths were reported due to accidents at locks and bridges or in the channel in the years examined. This is consistent with low mortality associated with barge linehaul operations nationwide. As far as spills are concerned, the data provided was insufficient to quantify the number of spills for the GREAT III reach. However, at high accident locations, the risk of cargo spills is greater. Therefore, by identifying these locations, the increased risk of cargo spills is documented.

1. Locks. The inability of locks to accommodate barge traffic restricts the flow of barge traffic. As discussed in Chapter V, Locks and Dams 25 and 26 represent constraints. Substantial delays will also occur at these two locations.

Locks can also present a navigation hazard because most tows are just slightly narrower than the available lock width. If the approach (by the tow) is not relatively straight, the lock structure can easily be rammed. Tight navigation at a lock is compounded by the "shoving" effect from the current on downbound tows, and the tendency for upbound barges to "dive" in the swirling currents below the dam. Underpowered towboats are susceptible to collision with the lock during entry and exit.

With respect to safety, Lock and Dam 24 has been identified as a site with major safety problems. Part of the problem at Lock and Dam 24 is that a wing dam intrudes into the channel at the upper entrance causing navigational problems and may partly explain a higher than normal accident rate reported at Lock and Dam 24. At Lock and Dam 25, a jetty exists creating a similar situation, but it is not considered a problem.

2. Bridges. "Bridges spanning the Mississippi River increase the risk of rammings because the bridge piers must be placed in the water. The greater the number of bridges, then the greater the risk, especially when horizontal clearances are limited. According to the Coast Guard study, rammings are highly likely when the horizontal clearance is less than twice the width of the tow.

Movable bridges present special problems because their horizontal clearances are typically narrow and failure to open in time can cause the tow to strike the overhead span. The NWS identified the Thebes railroad bridge at river mile 44 and the bridges in St. Louis Harbor area between river miles 172 and 184 as high accident bridges.[1] Besides the congestion at the Port of St. Louis, there are six bridges that must be successfully navigated in the GREAT III area. Other bridges in the GREAT III study area that pose safety hazards, are the Cairo highway bridge

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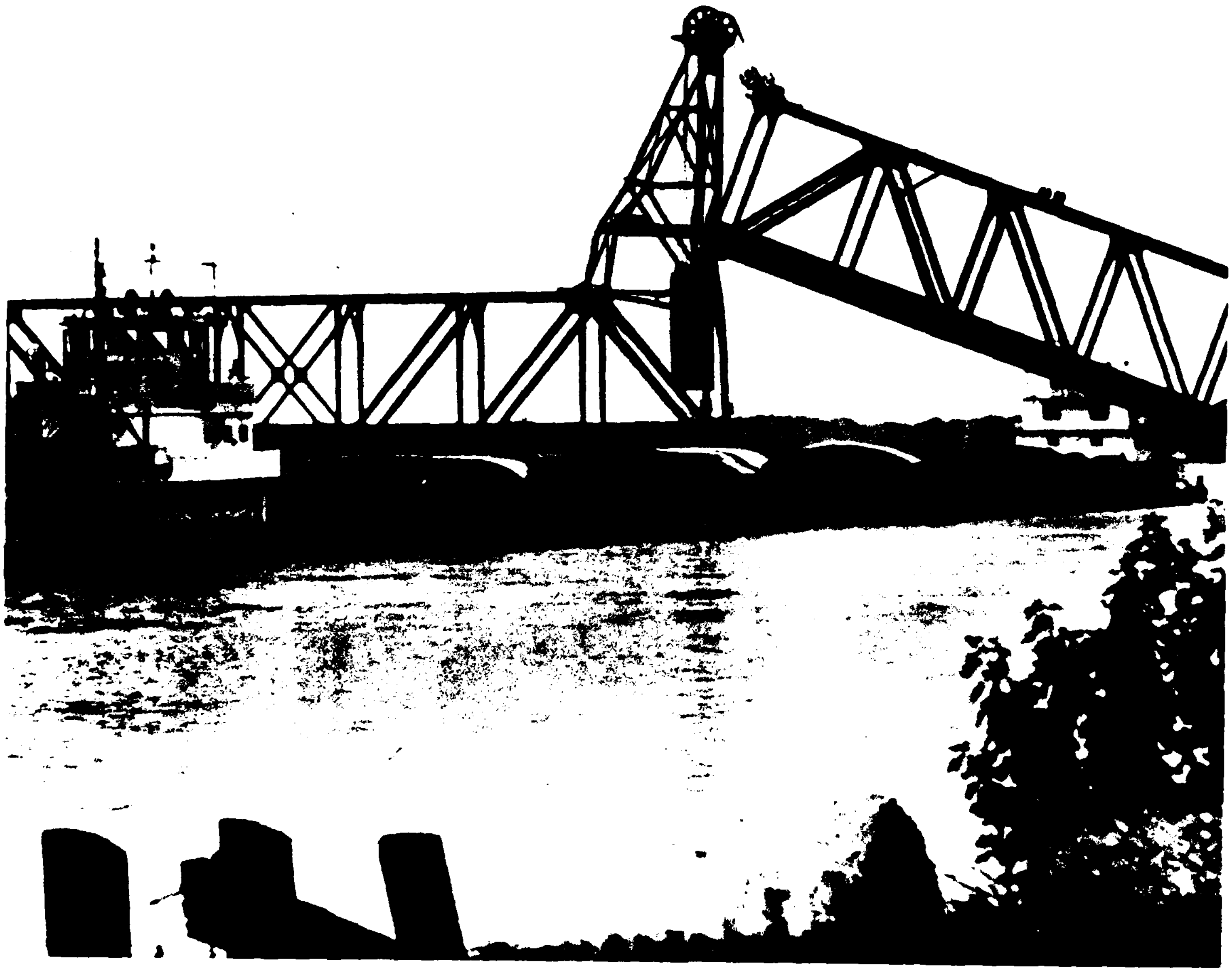
[1] NWS, Evaluation of Present Navigation System, Exhibit IV-3, pg. 152.



This inactive railroad bridge at Keithburg (RM 428) blocked the channel for nine days as a result of vandalism. Until removal by the Corps of Engineers, limited traffic was passed beneath the bridge from one towboat to another.

(mile 1.4), the Illinois Central Gulf swingspan (mile 282), and the Louisiana highway bridge (mile 283).

Interviews with master pilots revealed that railroad bridges in general are more of a hazard than highway bridges mainly because they are not maintained as well as the latter. Moreover, the pilots noted that the risk of rammings is greater because of the tendency of bridge tenders to open the bridge at the last moment.

Typically, when tows are involved in rammings, barges break away and drift downriver. They are usually stopped by other towboats or become grounded with minimal damage. However, in some cases they ram other vessels or structures, or become grounded and suffer structural damage.

High risk factors associated with rammings are fires, explosions, hazardous materials spills, and the release of toxic chemicals whenever the vessel is severely damaged. These risk factors are dependent upon the extent of vessel damage, the type of commodity, and the location of the accident. Cargo spills, especially toxic chemical releases (e.g., chlorine gas), are major safety risks because bridges (and piers and locks) are normally located in populated areas, thereby increasing the safety hazard.

3. Terminals. Similarly, rammings of piers and docks of terminals handling bulk hazardous materials, such as chemicals and petroleum products, present major safety hazards. These terminals generally have pipeline connections which can be severed resulting in fires, explosions, and spills which potentially could destroy storage tanks and the (refinery) plant itself.

4. Channels. Waterway system accidents can be associated with natural physical characteristics of the system. Channels where the direction and force of water currents and (to a lesser extent) wind effects are strong and subject to variation tend to cause vessel control accidents. Such accidents occur, because under these conditions, vessel maneuvering is difficult to execute with precision due to poor knowledge of effects, and unstable vessel response characteristics at low speeds. Current and wind effects are most noticeable at bends, intersections, bridges, dams, industrial water intakes and discharges and narrow channels. Occasionally, the wind and/or current will cause a towboat to lose all maneuvering control, and the forces exerted on the barges may break the lashings.

Channel configuration is a contributing factor to accidents for two reasons: it influences the current forces and can obscure the vision of the person in charge. Other contributing factors are river stage, sunken barges or vessels, submerged features (such as unmarked dikes, portions of old locks or bridges), and inadequate or missing navigation aids.

The types of accidents associated with these physical aspects of the channel are varied. Channel conditions can contribute to any of the accidents already discussed (lock accidents and bridge rammings), but are a principal factor in collisions and rammings between vessels, groundings and sinkings, and collisions with floating or submerged objects. As far as collisions between tows are concerned, these are rare occurrences and thus are given brief discussion here. The types of risks involved are similar to bridge rammings. Most of the damages are incurred by the vessels involved and their cargo. Cargo spills are often the result, and if loss of vessel control occurs, further rammings of bridges, piers, navigation aids, and other fixed objects can result. Even in collisions between tows, personnel casualties seldom occur.

Groundings, sinkings, and collisions with submerged objects are generally treated as channel accidents. Most groundings result in minor damages because vessel speeds are some usually low and the river bottom is usually soft material. Some groundings reflect the decision of the towboat pilot to ground his tow rather than risk another more serious accident (e.g., collision or ramming of bridge).

Table VII-2 shows the number of accidents by type for FY 78 on Western Rivers. As indicated, rammings and groundings are the more prevalent type of accident on these rivers which include the Mississippi River. The accompanying figure to this table graphically illustrates these statistics over time. As indicated in the diagram, the number of groundings increased sharply between 1973-1977. Possible contributory factors include: increased traffic, reduced frequency and depth of dredging, inadequate maintenance of channel markings, adverse weather (e.g., recent severe winter weather), and low flow.

Table VII-2

Incidence of Casualties
(Western Rivers)

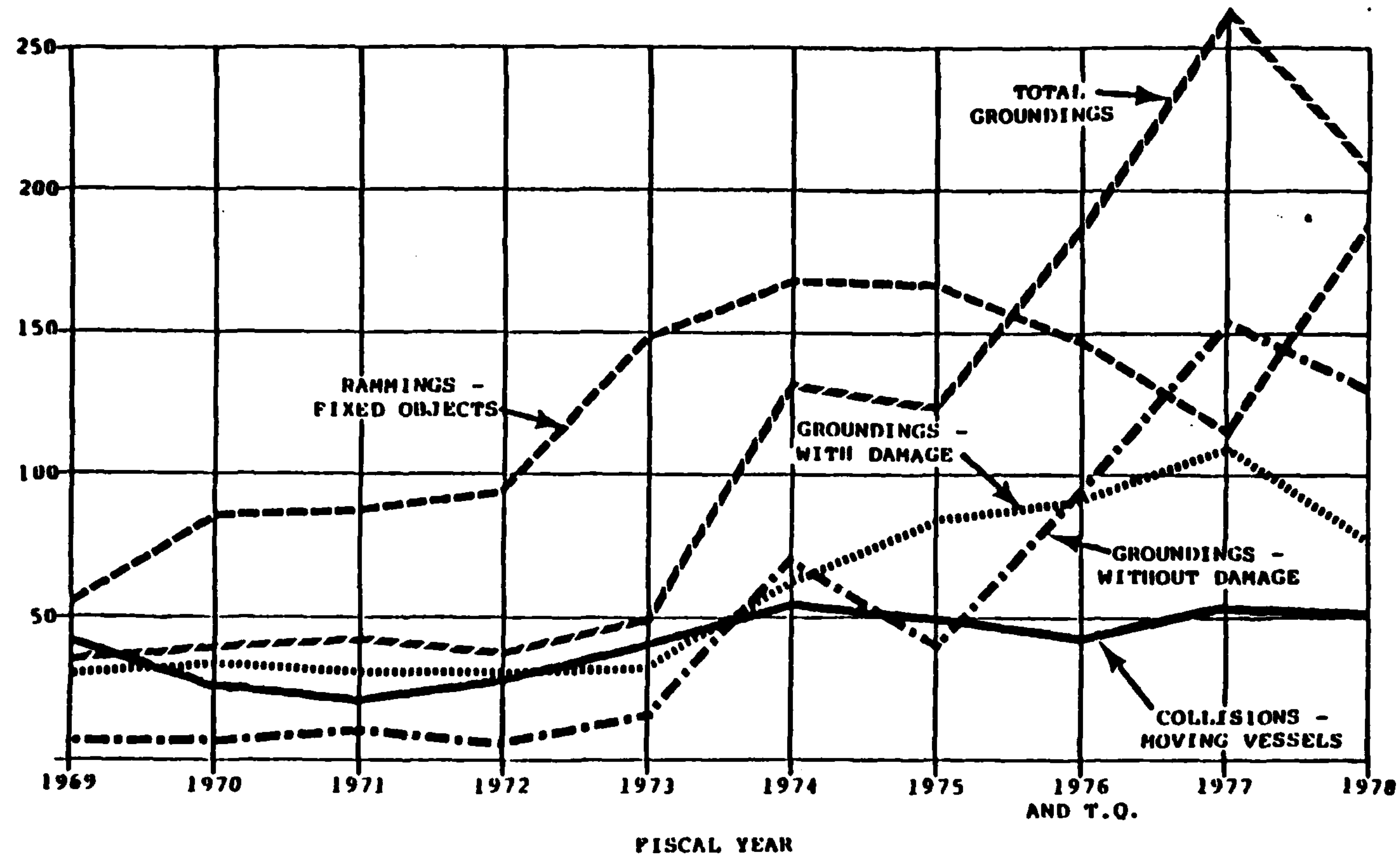
Type of Casualty	Number of Casualties FY 78
Collisions -	
Meeting, Crossing, Overtaking	51
While Anchored, Docking or Undocking	27
Other	32
Rammings -	
Piers, Bridges, Locks or Dams	189
Explosions and/or Fires -	
Cargo	-
Vessels's Fuel	-
Pressure Vessels, Boilers	-
Others	16
Groundings -	
With Vessel Damage	77
Without Vessel Damage	130
Founderings, Capsizings, Floodings	95
Heavy Weather Damage	-
Cargo Damage	-
Material Failures -	
Structure and Equipment	14
Machinery and Engineering Equipment	5
Total - All Types	672

Note: Total includes other casualty types not shown.

Source: U.S. Coast Guard Marine Safety Statistical Review - 1979.

Figure VII-1

VESSEL CASUALTIES
WESTERN RIVERS, 1969 to 1978



Source: U.S. Coast Guard Marine Safety Statistical Review, 1969-1978.

IMPACT EVALUATION OF CONSTRAINTS AT TERMINALS

Terminal capacity was found to be a constraint for the following commodity groups:

- Grain
- Coal
- Chemicals
- Iron and steel products.

Additional terminal capacity must be brought on line for these commodity groups in the year 1990 and/or 2000. The impact of adding this new capacity is measured by the potential number of new jobs created and the increment to the region's tax base. Another potential impact measured is the amount of tonnage that is not accommodated if the projected shortfalls in terminal capacity are not alleviated.

(a) Tonnage Not Handled

The amount of tonnage not handled if new terminals are not built to handle projected traffic of commodities for which a shortfall in terminal capacity is forecasted is an impact that was addressed. This impact is easily measured and in fact was a preliminary step in determining the new terminal requirements of a previous section.

The methodology used to estimate the amount of tonnage not handled involved several steps which were discussed earlier in relation to the terminal constraint analysis. It will suffice to say here that "effective" terminal capacity was compared to projected traffic for the various commodity groups in order to estimate the amount of tonnage not handled or the shortfall in capacity.

Estimates of the tonnage not handled are provided in Table VII-3.

Table VII-3

Tonnage Not Handled Due to
Insufficient Terminal Capacity

Commodity	Tonnage to be Absorbed 60% 1990	60% 2000	80% 1990	80% 2000
	(Thousands of Tons)			
Grain	26	4,360	-	757
Chemicals	301	1,770	-	912
Coal	-	2,860		
Iron and Steel Products	697	1,080	140	519
Total	1,024	10,070	140	2,188

It is quite evident that the severity of the impact depends on which criterion is used to determine when terminal capacity becomes a constraint. When 80 percent of total terminal capacity is used as the benchmark, a total of 2.2 million tons in the year 2000 will be lost, whereas under the 60 percent rule 10.1 million tons in the year 2000 will be lost. Under the 60 percent rule, 10.1 million tons represents a significant loss, 14.9 percent of the total amount of traffic forecasted for 2000 (according to the baseline scenario).

Capacity of existing facilities handling the other commodity groups not shown in the table seems to be sufficient to absorb the projected increases in tonnages.

(b) Employment

To determine the impact on employment resulting from bringing additional capacity on line, the following approach was taken. First, data were collected on the number of establishments and employees for those commodity classifications requiring additional terminal capacity. Appropriate SIC codes were chosen for both shipments and receipts for affected commodities as these differed in those cases where the commodity received was transformed into a different product before shipment, e.g., chemicals. Employment data were gleaned from 1979 County Business Patterns for selected counties in Illinois and Missouri. These counties are listed in Table VII-4.

Table VII-4

Counties Selected to Determine Employment Effects

Missouri	Illinois
Cape Girardeau	Madison
Jefferson	St. Clair
St. Louis	Monroe
	Randolph

The typical size of establishment (by number of employees) was determined for each affected commodity and the relevant SIC codes. These sizes are provided in Table VII-5 below.

Table VII-5

SIC Codes and Average Establishment Sizes

	SIC Code	Average Size Est. (Number of Employees)
Grain		
Inbound	5153	15
Outbound	5153	15
Coal		
Inbound	491,493	164
Outbound	4463	52
Chemicals		
Inbound	28	82
Outbound	281,286	329
Iron and Steel		
Inbound	5051	16
Outbound	33	275

Next, the number of new jobs created was estimated. Both a direct employment effect, and an indirect employment effect (i.e., employment in auxiliary industries resulting from the new facility being built) were estimated. The direct employment effect was estimated by multiplying the number of new terminals required by the average size of an establishment. The indirect employment effect was then determined by multiplying the direct effect by the appropriate regional multiplier minus one. The total employment effect is the summation of the direct and indirect effects. (The values for the multipliers were taken from "An Input-Output Model of the St. Louis Region, 1972," by Floyd K. Harmston).

Employment effects were estimated for the baseline, high use, and low use scenarios and for each of these according to the user charge scenario. In addition, the analysis was conducted for both sizes of establishments where there was a difference in SIC codes for inbound and outbound products. Therefore, the employment effect is different depending upon whether the terminal is primarily engaged in shipping or receiving operations.

The detailed employment impacts of adding new terminal capacity are provided in Exhibits VII-1 through VII-6. The impacts are summarized in Table VII-6. According to average size of establishments, chemicals and iron and steel facilities are the most job intensive of the new terminals that need to be brought on line. (The average sizes of chemicals and iron and steel facilities primarily engaged in shipping operations are 329 and 275 employees, respectively). Since chemicals was a principal area requiring new terminal capacity, it is not surprising that the largest number of jobs created would be in new chemical processing facilities. Following chemical facilities are iron and steel manufacturing concerns, despite the fact that relatively few new terminals need to be brought on line in either 1990 or 2000 under any scenario. Although under the 60 percent criterion for determining new terminal requirements the greatest need was for grain facilities, these are for transshipment facilities that do not involve many jobs and therefore the employment impact is rather small. According to the user charge scheme, the same pattern of employment gains is realized.

The employment impacts differ significantly across scenarios. However, greater variation occurs between the 60 percent and 80 percent criteria.

Under the user charge scheme, the only difference between scenarios for year 2000 under the 80 percent criterion is that an iron and steel facility must be built according to the low use scenario (a maximum gain of 582 jobs). For the year 2000 under the 60 percent criterion, low use differs from baseline and high use in that three grain and three chemical facilities are needed instead of four in each case. Also, under high use two coal facilities are required instead of one as under baseline or low use.

For the year 1990 under the user charge scheme, there is no employment effect according to the 80 percent criterion because no new terminals are necessary. Under the 60 percent criterion, only one new iron and steel facility is needed according to each scenario.

The maximum employment impacts are summarized in Table VII-6. As can be seen, there is significant difference in the number of jobs created depending on whether the 60 percent or 80 percent new terminal criterion is used. The greatest number of new jobs created are found under the 60 percent criterion - for the high use scenario for the year 2000, 6,049 new jobs. The number of new jobs under the scenarios according to the user charge scheme are markedly reduced compared to those of the basic scenarios.

Table VII-6

Maximum Employment Impacts

	Year			
	1990		2000	
Scenario	60%	80%	60%	80%
Baseline	1,700	582	5,595	3,755
High Use	1,700	582	6,049	3,755
Low Use	2,192	582	5,595	2,727
User Charge:				
Baseline	582	0	5,505	1,028
High Use	582	0	5,959	1,028
Low Use	582	0	4,388	1,028
Rail Merger				
Baseline	582	0	5,142	3,755
High Use	582	0	5,142	3,755
Low Use	582	0	5,142	2,727

Note: The 60 percent and 80 percent designations correspond to the 60 percent and 80 percent criterion used to determine the number of new terminals required.

The employment impacts of the rail merger scenario vary from the underlying baseline, high use, and low use forecasts only under the 60 percent criterion in the year 2000. This is because the new coal terminal requirements are such a small component of the total requirements, and, in some cases are zero.

3. The Investment Effect. A second evaluation measure used to assess the impact of building new terminal capacity is the increment to the region's tax base resulting from the investment in new terminals. To estimate the tax base effect properly requires both an estimate of the amount of the investment and the assessment value of that investment. However, assessment ratios vary widely from location to location (as various boundaries are crossed) within the study area. To avoid these complexities, the simple approach was taken to estimate the impact on the tax base by determining the amount of investment that the new terminals will entail. The exact tax base effect on a particular location can then be determined by applying the relevant assessment ratio to the cost of the investment.

Order-of-magnitude cost estimates for the facilities and their respective capacities are listed in Table VII-7 below:

Table VII-7

Estimated Investment Required for New Terminals

Facility Type	Annual Capacity	Investment per Facility
Grain	740,000 tons	$ 4,000,000
Coal	3,900,000 tons	35,000,000
Chemical	363,000 tons	3,200,000
Iron and Steel	545,000 tons	2,900,000

Based on these order-of-magnitude costs, the impact on the tax base was determined by multiplying these costs by the number of new terminals required. The amounts of investment are indicated in Table VII-8 and Table VII-9.

Investment in a coal facility (under the 60 percent criterion) represents the largest increment to the tax base, $35 million, followed by grain, chemicals, and iron and steel. However, across both the 60 percent and 80 percent criteria and across scenarios, investment in chemical processing facilities collectively adds substantially to the region's tax base, and as indicated earlier will provide the largest employment gains.

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Table VII-8

Investment Impact of New Terminals

Scenario/ Commodity	Level of Investment: 60% Criterion 1990	60% Criterion 2000	60% Criterion Total	80% Criterion 1990	80% Criterion 2000	80% Criterion Total
	(Millions $)			(Millions $)		
Baseline						
Grain	4	20	24	-	4	4
Coal	-	35	35	-	-	-
Chemicals	3.2	12.8	16	-	9.6	9.6
Iron and Steel	2.9	2.9	5.8	2.9	2.9	5.8
Low Use						
Grain	-	20	20	-	4	4
Coal	-	35	35	-	-	-
Chemicals	3.2	12.8	16	-	6.4	6.4
Iron and Steel	5.8	2.9	8.7	2.9	2.9	5.8
High Use						
Grain	4	20	24	-	4	4
Coal	-	70	70	-	-	-
Chemicals	3.2	12.8	16	-	9.6	9.6
Iron and Steel	2.9	2.9	5.8	2.9	2.9	5.8

Table VII-9

Investment Impact of New Terminals

User Charge

Scenario/ Commodity	60% Criterion 1990	60% Criterion 2000	60% Criterion Total	80% Criterion 1990	80% Criterion 2000	80% Criterion Total
	(Millions $)			(Millions $)		
Baseline						
Grain	-	16	16	-	-	-
Coal	-	35	35	-	-	-
Chemicals	-	12.8	12.8	-	3.2	3.2
Iron and Steel	2.9	2.9	5.8	-	-	-
Low Use						
Grain	-	12	12	-	-	-
Coal	-	35	35	-	-	-
Chemicals	-	9.6	9.6	-	3.2	3.2
Iron and Steel	2.9	2.9	5.8	-	2.9	2.9
High Use						
Grain	-	16	16	-	-	-
Coal	-	70	70	-	-	-
Chemicals	-	12.8	12.8	-	3.2	3.2
Iron and Steel	2.9	2.9	5.8	-	-	-

IMPACT EVALUATION OF CONSTRAINTS IN FLEETING CAPACITY

The impact evaluation measure selected for fleeting is the incremental costs imposed on users. This measure was selected because it is unlikely that commerce would fail to move solely because of fleeting problems. Rather, fleet constraints would likely increase the cost of fleeting service.

In general linehaul barge and towing operators strive to maximize utilization of their most costly equipment, namely their large linehaul boats and crews. Thus, barges may be allowed to accumulate for many days and incur relatively high waiting times in fleeting areas before additional linehaul boats are put into operation. This practice minimizes the risk of idle time being incurred by linehaul boats. The tradeoff in hourly costs between linehaul boats and barges for two different tow sizes is shown in Table VII-10.

Table VII-10

Towboat and Barge Hourly Cost Comparison (1)

Equipment	Tow Size in Number of Barges: 15	25
35' x 195' Open Hopper Barges	$74	$123
Linehaul Towboats	144(2)	193(3)

Notes: (1) Based on a 20 year life and a 10 percent capital recovery factor.
(2) Estimated hourly standby cost for a 4,500 horsepower boat and crew.
(3) Estimated hourly standby cost for a 7,500 horsepower boat and crew.

As can be seen from Table VII-10, the standby cost for the linehaul towboats far exceeds the standby cost for barges.

These two tow sizes were selected for analysis because the sub-reach where the shortage in fleeting capacity is expected to occur is where most of the reconfiguration of tows occurs for through traffic. The maximum tow size for traffic above the lowest lock, Locks 27, is 15 barges. Below the Chain of Rocks

Canal, where Locks 27 are located, the channel will accommodate 25 barge tows.

Clearly much traffic does not travel in the maximum tow size. However, the most efficient operators tend to determine rates at the economic margin. Therefore, these maximum tow sizes are used for evaluation purposes.

As the utilization of the fleets in the sub-reach approaches capacity, fleet operators will attempt to either expand existing capacity or establish new sites. These new sites may be within the sub-reach. It is more likely that additional sites will be established below the boundary of the sub-reach, mile 163.

In the event that additional fleeting capacity is not added, the likely response of linehaul operators will be to make additional towboat capacity available at the risk of incurring some additional idle time. If it is assumed that the average storage period of a barge drops from 3.5 to 2.5 days, then the existing capacity in the problem sub-reach will be able to accommodate the projected increase in fleeting requirements under the baseline scenario. If it is further assumed that for every day cut off of the barge time, linehaul towboats incur a day of standby time, and all tows are 15 barge tows, then the incremental cost per 15 barges would be $1,680 per day.

Since all traffic would be affected by the increase in fleet turnover, the incremental cost would be the total barges times $1,680 divided by 15, or roughly $19.7 million annually in the year 2000. This would represent a maximum impact.

If additional fleeting capacity is added below mile 163, incremental costs would still be incurred due to tradeoff in linehaul operations of 15 barge tows and 25 barge tows. The ton-mile cost differential is approximately 2.4 mills between these tow sizes. If it is assumed that new fleeting sites require 10 miles of additional travel by upstream (15 barge) tows and 10 miles less travel by downstream (25 barge) tows, the cost per ton would be $0.024. It is further assumed that the competitive market place imposes the additional cost on all tons in the form of increased rents for existing sites, then the incremental fleeting cost under the baseline scenario in the year 2000 would be the product of 138,857,000 tons multiplied by $0.024, or roughly $3.3 million, even if new capacity is provided. This would represent a minimum impact.

As this analysis shows the cost associated with fleeting will go up even if additional capacity is added. Since the actual response of industry will combine the more intensive use of some existing capacity with the creation of new capacity, the total cost impact will fall between the maximum and the minimum. Traffic originating and terminating in the sub-reach from Locks 27 to mile 163 in particular will not find new capacity below mile 163 particularly useful. The weighted average of the maximum and minimum estimates, using the percentage of originating and terminating traffic and the percentage of through traffic as weights respectively, is $9.8 million annually. This is considered to be the incremental cost impact.

EXHIBIT VII-1

EMPLOYMENT IMPACTS OF NEW TERMINALS
YEAR 2000

	Baseline			High Use			Low Use		
Under 80% Criterion:	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Grain									
In	15	30	45	15	30	45	15	30	45
Out	15	30	45	15	30	45	15	30	45
Coal									
In	-	-	-	-	-	-	-	-	-
Out	-	-	-	-	-	-	-	-	-
Chemicals									
In	246	369	615	246	369	615	164	246	410
Out	987	1,481	2,468	987	1,481	2,468	658	987	1,645
Iron and Steel									
In	16	16	32	16	16	32	16	16	32
Out	275	275	550	275	275	550	275	275	550
Under 60% Criterion:									
Grain									
In	75	150	255	75	150	225	75	150	225
Out	75	150	255	75	150	225	75	150	225
Coal									
In	164	180	344	328	361	689	164	180	344
Out	52	57	109	104	114	218	52	57	109
Chemicals									
In	328	492	820	328	492	820	328	492	820
Out	1,316	1,974	3,290	1,316	1,974	3,290	1,316	1,974	3,290
Iron and Steel									
In	16	16	32	16	16	32	16	16	32
Out	275	275	550	275	275	550	275	275	550

Source: A. T. Kearney, Inc.

EXHIBIT VII-2

EMPLOYMENT IMPACTS OF NEW TERMINALS
YEAR 1990

	Baseline			High Use			Low Use		
Under 80% Criterion:	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Grain									
In	-	-	-	-	-	-	-	-	-
Out	-	-	-	-	-	-	-	-	-
Coal									
In	-	-	-	-	-	-	-	-	-
Out	-	-	-	-	-	-	-	-	-
Chemicals									
In	-	-	-	-	-	-	-	-	-
Out	-	-	-	-	-	-	-	-	-
Iron and Steel									
In	16	16	32	16	16	32	16	16	32
Out	275	275	550	275	275	550	275	275	550
Under 60% Criterion:									
Grain									
In	15	30	45	15	30	45	-	-	-
Out	15	30	45	15	30	45	-	-	-
Coal									
In	-	-	-	-	-	-	-	-	-
Out	-	-	-	-	-	-	-	-	-
Chemicals									
In	82	123	205	82	123	205	82	123	205
Out	329	494	823	329	494	823	329	494	823
Iron and Steel									
In	16	16	32	16	16	32	32	32	64
Out	275	275	550	275	275	550	550	550	1,100

Source: A. T. Kearney, Inc.

EXHIBIT VII-3

EMPLOYMENT IMPACTS OF NEW TERMINALS
USER CHARGE (2000)

	Baseline			High Use			Low Use		
Under 80% Criterion:	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Grain									
In	-	-	-	-	-	-	-	-	-
Out	-	-	-	-	-	-	-	-	-
Coal									
In	-	-	-	-	-	-	-	-	-
Out	-	-	-	-	-	-	-	-	-
Chemicals									
In	82	123	205	82	123	205	82	123	205
Out	329	494	823	329	494	823	329	494	823
Iron and Steel									
In	-	-	-	-	-	-	16	16	32
Out	-	-	-	-	-	-	275	275	550
Under 60% Criterion:									
Grain									
In	60	120	180	60	120	180	45	90	135
Out	60	120	180	60	120	180	45	90	135
Coal									
In	164	180	344	328	361	689	164	180	344
Out	52	57	109	104	114	218	52	57	109
Chemicals									
In	328	492	820	328	492	820	246	369	615
Out	1,316	1,974	3,290	1,316	1,974	3,290	987	1,481	2,468
Iron and Steel									
In	16	16	32	16	16	32	16	16	32
Out	275	275	550	275	275	550	275	275	550

Source: A. T. Kearney, Inc.

EMPLOYMENT IMPACTS OF NEW TERMINALS
USER CHARGE (1990)

	Baseline			High Use			Low Use		
Under 80% Criterion:	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Grain									
In	-	-	-	-	-	-	-	-	-
Out	-	-	-	-	-	-	-	-	-
Coal									
In	-	-	-	-	-	-	-	-	-
Out	-	-	-	-	-	-	-	-	-
Chemicals									
In	-	-	-	-	-	-	-	-	-
Out	-	-	-	-	-	-	-	-	-
Iron and Steel									
In	-	-	-	-	-	-	-	-	-
Out	-	-	-	-	-	-	-	-	-
Under 60% Criterion:									
Grain									
In	-	-	-	-	-	-	-	-	-
Out	-	-	-	-	-	-	-	-	-
Coal									
In	-	-	-	-	-	-	-	-	-
Out	-	-	-	-	-	-	-	-	-
Chemicals									
In	-	-	-	-	-	-	-	-	-
Out	-	-	-	-	-	-	-	-	-
Iron and Steel									
In	16	16	32	16	16	32	16	16	32
Out	275	275	550	275	275	550	275	275	550

Source: A. T. Kearney, Inc.

EXHIBIT VII-5

EMPLOYMENT IMPACTS OF NEW TERMINALS
RAIL MERGER (2000)

	Baseline			High Use			Low Use		
Under 80% Criterion:	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Grain									
In	15	30	45	15	30	45	15	30	45
Out	15	30	45	15	30	45	15	30	45
Coal									
In	-	-	-	-	-	-	-	-	-
Out	-	-	-	-	-	-	-	-	-
Chemicals									
In	246	369	615	246	369	615	164	246	410
Out	987	1,481	2,468	987	1,481	2,468	658	987	1,645
Iron and Steel									
In	16	16	32	16	16	32	16	16	32
Out	275	275	550	275	275	550	275	275	550
Under 60% Criterion:									
Grain									
In	75	150	255	75	150	225	75	150	225
Out	75	150	255	75	150	225	75	150	225
Coal									
In	-	-	-	-	-	-	-	-	-
Out	-	-	-	-	-	-	-	-	-
Chemicals									
In	328	492	820	328	492	820	328	492	820
Out	1,316	1,974	3,290	1,316	1,974	3,290	1,316	1,974	3,290
Iron and Steel									
In	16	16	32	16	16	32	16	16	32
Out	275	275	550	275	275	550	275	275	550

Source: A. T. Kearney, Inc.

EXHIBIT VII-6

EMPLOYMENT IMPACTS OF NEW TERMINALS
RAIL MERGER (1990)

	Baseline			High Use			Low Use		
Under 80% Criterion:	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Grain									
In	-	-	-	-	-	-	-	-	-
Out	-	-	-	-	-	-	-	-	-
Coal									
In	-	-	-	-	-	-	-	-	-
Out	-	-	-	-	-	-	-	-	-
Chemicals									
In	-	-	-	-	-	-	-	-	-
Out	-	-	-	-	-	-	-	-	-
Iron and Steel									
In	16	16	32	16	16	32	16	16	32
Out	275	275	550	275	275	550	275	275	550
Under 60% Criterion:									
Grain									
In	15	30	45	15	30	45	-	-	-
Out	15	30	45	15	30	45	-	-	-
Coal									
In	-	-	-	-	-	-	-	-	-
Out	-	-	-	-	-	-	-	-	-
Chemicals									
In	82	123	205	82	123	205	82	123	205
Out	329	494	823	329	494	823	329	494	823
Iron and Steel									
In	16	16	32	16	16	32	32	32	64
Out	275	275	550	275	275	550	550	550	1,100

Source: A. T. Kearney, Inc.

VIII - CONCLUSIONS AND RECOMMENDATIONS

This section summarizes the conclusions and recommendations of the contractor team for the GREAT III Commercial Transportation Work Group and the Industrial and Economic Development Work Group The conclusions and recommendations are organized in a manner consistent with the various tasks of the study.

INVENTORIES

(a) Conclusions

Database discrepancies, in waterborne commerce data and the status and location of terminals, make analysis and consequent effective management of the navigation system difficult.

(b) Recommendations

The Corps should be provided adequate funding and should be required to update and monitor its permits to a level of accuracy that, at least identifies facilities (including fleeting areas). Moreover, the Corps should consider requiring permit holders to keep the Corps informed of the identity of their current responsible officer or agent.

CONSTRAINTS

(a) Channels

1. Conclusions. Channels in the GREAT III study area are not expected to constrain traffic growth. Some existing hazards to navigation are the result of natural conditions, inadequate maintenance in some areas, and sunken barges in others. Although the reliability of channel markings has improved markedly in recent years, further improvement in reliability is desirable and additional markings are needed at some locations.

2. Recommendations. Congress should provide adequate funding for the required maintenance of channels, including both dredging and river training works. The Corps should consider either increasing the frequency of dredging or increasing overdraft dredging of sites where pilots have reported problems. Congress should continue to ensure adequate funding for maintenance of channel markers and buoys. The Coast Guard should evaluate the need for additional channel markers at the known hazardous sites.

The Corps should strictly enforce existing regulations (Sections 15, 16, 19 and 20 of the River and Harbor Act), requiring the owners of all sunken commercial vessels and barges to remove them routinely. Where the owners cannot be located or forced to remove them, specific funding should be sought for removal at federal expense.

(b) Bridges

1. Conclusions. Bridges in the GREAT III study area create safety problems for commercial traffic but will not constrain traffic during the time horizon of the study. Many bridges in the study area are hazardous for navigation and are the sites of frequent marine casualties. The physical setting of some bridges contribute to problems at some locations, and narrow horizontal clearances, particularly at movable bridges, impose one way traffic restrictions. These constrictions in turn create occasional delays and additional hazards in passing through the bridges. Late openings by bridge operators also create hazards.

2. Recommendations. Movable bridges should be left open for the free passage of tows unless the frequency of train traffic exceeds the frequency of barges and other vessels. The Coast Guard should immediately review with the bridge owner the operation of the Louisiana Railroad Bridge, operated by the Illinois Central Gulf Railroad, to determine the feasibility of leaving it open.

(c) Locks

1. Conclusions. Locks and Dam 26 will constrain future growth of waterborne commerce in the study area, even after the new single 110' x 1,200' chamber currently under construction is completed. According to UMRBC Master Plan analysis this will occur in 1995. The National Waterways Study predicts a constraint in 1990.

Lock and Dam 25 will constrain the growth of waterborne commerce late in the study period, according to the UMRBC Master Plan analysis. However, this lock constraint will be effective only if additional capacity is added at both Locks and Dam 26 and Lock and Dam 22.

2. Recommendations. Congress should accept the recommendation of the UMRBC Master Plan for a second chamber at the new site of Locks and Dam 26 and provide for the completion of all construction on a timely basis in order to accommodate projected traffic.

Lock and Dam 25 should be reexamined in detail in 5 years by the Corps to verify the need for additional capacity. The Corps should also adopt an active program of non-structural and minor structural maintenance at all locks, as appropriate, to improve operating efficiency, particularly during peak periods.

(d) Terminals

1. Conclusions. A need for additional terminal capacity for four major commodity groups is expected to occur by the end of the study period. Higher user charges on the inland waterways and/or mergers of key railroads will probably reduce this need somewhat. Nevertheless, even under the most pessimistic combination of scenarios, shippers are expected to construct additional terminal capacity.

2. Recommendations. Local port authorities and development agencies should continue to develop programs to promote port expansion, including the funding of necessary infrastructure improvements for preferred industrial sites, and to ensure the timely identification and resolution of other problems impeding growth.

Federal agencies should seek closer consultation with local authorities to ensure that valid federal concerns are dealt with early in the development process.

(e) Fleeting

1. Conclusions. A lack of fleeting space is a localized problem rather than an area wide problem. Most of the sub-reaches of the study area subjected to analysis will have adequate fleeting capacity in the foreseeable future. One sub-reach, from Locks 27 to mile 136 will experience a substantial shortfall of fleeting capacity by the end of the study period. Whether additional capacity is provided by increasing utilization of existing facilities or by adding capacity below mile 136, the cost to private users is expected to increase.

2. Recommendations. Local agencies should develop an inventory of potential fleeting sites in the areas where capacity shortfalls are expected, and take steps to ensure their availability. These steps could range from zoning, to obtaining options, to outright acquisition. The cooperation of federal agencies should be sought in resolving regulatory problems for these sites in advance of needs.

(f) Regulatory Constraints

1. Conclusions. Numerous instances of delay, additional cost, and confusion were found due to regulatory constraints. In general, those private interests that initiated their applications early in the development planning process and maintained continuous liaison with the various public agencies and other affected groups fared better in completing their projects on schedule.

While individual regulatory requirements may seem to serve sound public purposes, overlapping and redundant regulatory requirements were found. The permit requirements of the State of Illinois were singled out by survey respondents as being particularly onerous and serving purposes already served by federal requirements.

The number of requirements, in itself, is a major source of confusion resulting in uncertainty and additional delay. This situation is expected to continue in the future, making it more difficult to develop river-related growth opportunities. At the same time, valid regulatory objectives are served less effectively than they could otherwise be served.

2. Recommendations. Local development agencies should provide better informational packets to potential industrial candidates cataloguing all laws and rules affecting development in the study area. Such a catalogue would also provide a more complete basis for identifying and eliminating unnecessary laws and regulations. Federal, state, and local laws and rules identified as unnecessary or redundant should be submitted to responsible authorities for action.

Regulatory bodies should ensure the dissemination of timely and accurate information about requirements and procedures for obtaining permits. Moreover, federal, state and local authorities should be explicit about the criteria used in applying their laws, and be consistent in their administration.

(g) Other

1. Recommendation. The Corps in conjunction with the Coast Guard should develop a multi-agency safety program and/or institute a safety task force charged with addressing the safety hazards within the GREAT III reach.

LAND AVAILABILITY

(a) Conclusions

Ample supplies of potentially developable land exist in the GREAT III study area. Thirty four locations with the best potential were identified out of 136 which were screened.

(b) Recommendations

Local development agencies should initiate the necessary environmental, archaeological and flood hazard analyses to ensure timely resolution of problems. These agencies should identify potential locations and ensure their availability to be developed by pursuing development of infrastructure improvements for preferred sites. Sites with significant problems should be removed from the inventory or assigned low development priority.

APPENDIX A

Description of Laws and Regulations

The purpose of this appendix is to describe more fully the various laws and regulations of the Federal Government and the State of Illinois identified during the course of analyzing regulatory problems which have impeded or are perceived to impede river related economic development in the GREAT III study area.

FEDERAL LAWS AND REGULATIONS

Section 9 of the River and Harbor Act approved March 3, 1899, (30 Stat. 1151; 33 USC 401) prohibits the construction of any dam or dike across any navigable water of the United States in the absence of Congressional consent and approval of the plans by the Chief of Engineers and the Secretary of the Army. Where the navigable portions of the waterbody lie wholly within the limits of a single State, the structure may be built under authority of the legislature of that State, if the location and plans of any modification thereof, are approved by the Chief of Engineers and by the Secretary of the Army. The instrument of authorization is designated a permit.

Section 10 of the River and Harbor Act approved March 3, 1899, (30 Stat. 1151; 33 USC 403) prohibits the unauthorized obstruction or alteration of any navigable water of the United States. The construction of any structure in or over any navigable water of the United States, the excavation from or depositing of material in such waters, or the accomplishment of any other work affecting the course, location, condition, or capacity of such waters is unlawful unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of the Army. The authority of the Secretary of the Army to prevent obstructions to navigation in the navigable waters of the United States was extended to artificial islands and fixed structures located on the outer continental shelf by Section 4 (e) of the Outer Continental Shelf Lands Act of 1953 (67 Stat. 463; 43USC 1333). In accordance with Section 154 of PL 94-587, Section 10 permits are not required to construct wharves and piers in any waterbody located entirely within one State that is a navigable water of the U.S. solely on the basis of its historical use to transport interstate commerce. Section 154 applies only to a single pier or wharf and not to marinas nor to any pier or wharf that would cause an unacceptable impact on navigation.

Section 1 of the River and Harbor Act of June 13, 1902 (32 Stat. 371; 33 USC 565) allows any persons or corporations desiring to improve any navigable river at their own expense and risk to do so upon the approval of the plans and specifications by the Secretary of the Army and the Chief of Engineers. Improvements constructed under this authority, which are primarily in Federal project areas, remain subject to the control and supervision of the Secretary of the Army and the Chief of Engineers.

Various sections of the Federal Water Pollution Control Act (FWPCA), also known as the Clean Water Act, restrict or impede development. The discharge of pollutants from point sources into the waters of the United States is prohibited by Section 301 of the Federal Water Pollution Control Act Amendments of 1972 unless the discharge is in compliance with Sections 402 and 404 of the Act. Section 402 establishes The National Pollutant Discharge Elimination System (NPDES), which is administered by the Administrator of the Environmental Protection Agency (EPA). This authority has been delegated to the states in most instances. Permits could be required for certain dredging operations (e.g., overflows from hopper dredges) and dredged material disposal operations (e.g., overflows from diked disposal areas).

Under Section 404 of the FWPCA, the COE specifies disposal sites based on the application of Guidelines developed by the Administrator of EPA in conjunction with the Secretary of the Army acting through the Chief of Engineers. In any case where such Guidelines alone would prohibit the specification of a disposal site, the COE may still specify a site through the additional application of the economic impact of the site of navigation and anchorage. The Administrator may deny or restrict the specification or use of any disposal when he determines, after the opportunity for hearing and consultation with the COE, that a discharge will have an acceptable adverse effect on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding areas), wildlife, or recreational areas.

EPA has promulgated guidelines which revise and clarify the September 5, 1975 interim final guidelines regarding discharge of dredged or fill material into waters of the U.S. in order to:

(a) Reflect the 1977 Amendments of Section 404 of the Clean Water Act,

(b) Correct inadequacies in the interim final guidelines by filling gaps in explanations of unacceptable adverse impacts on aquatic and wetland ecosystems and by requiring documentation of compliance with the guidelines, and

(c) Produce a final rule-making document.

New 404 (b) (1) guidelines were published 24 December, 1980. Guidelines for testing designed and fill material are pending.

Section 404 of the Clean Water Act of 1977 (33 USC 1344) authorizes the Secretary of the Army, acting through the Chief of Engineers, to issue permits, after notice and opportunity for public hearings, for the discharge of dredged or fill material into the water of the United States at specified disposal sites. The selection and use of disposal sites will be in accordance with guidelines developed by the Administrator of the Environmental Protection Agency (EPA) in conjunction with the Secretary of the Army published in 40 CFR Part 230. If these guidelines prohibit the selection or use of a disposal site, the Chief of Engineers may consider the economic impact on navigation of such a prohibition in reaching his decision. Furthermore, the Administrator can prohibit or restrict the use of any defined area as a disposal site whenever he determines, after notice and opportunity for public hearings and after consultation with the Secretary of the Army, that the discharge of such materials into such areas will have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas, wildlife, or recreational areas.

Section 401 of the Clean Water Act (33 USC 1341) requires any non-Federal applicant for a Federal license or permit, that may result in a discharge of a pollutant into waters of the United States, to obtain State certification that the discharge will comply with the applicable effluent limitations and water quality standards. A certification obtained for the construction of any facility must also pertain to the subsequent operation of the facility.

The Fish and Wildlife Coordination Act (PL 85-624; 16 U.S.C. 661 et seq.) amended the Act of March 10, 1934 to provide that fish and wildlife conservation shall receive equal consideration with other project purposes and be coordinated with other features of water resource development programs. Adverse effects on fish and wildlife resources and opportunities for improvement of those resources shall be examined along with other purposes which might be served by water resource development. The Corps of Engineers may recommend project modifications and acquisition of lands for fish and wildlife conservation purposes. Section 2 (a) of the Act defines the area of interest to include impoundment, diversion, channel deepening, or any modification of a stream or other body of water.

In accordance with the Fish and Wildlife Coordination Act the Corps consults with the United States Fish and Wildlife Service, the National Marine Fisheries Services (as appropriate) and with the head of the appropriate State agency exercising administration over the wildlife resources of the affected State before permits are issued. Applicants are urged to modify proposals to eliminate or mitigate any damage to fish and wildlife resources when possible.

The Endangered Species Act of 1973 (16 USC 1531 et seq.) declares the intention of the Congress to conserve threatened and endangered species and the ecosystems on which those species depend. The Act provides that Federal agencies must utilize their authorities in furtherance of its purposes by carrying out programs for the conservation of endangered or threatened species, and by taking such action necessary to insure that any action authorized by that Agency will not jeopardize the continued existence of such endangered or threatened species or result in the destruction or modifications of habitat of such species which is determined by the Secretaries of Interior or Commerce, as appropriate, to be critical.

The Act states that the policy of Congress is that all federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of this Act. The purposes of this Act are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved and to provide a program for the conservation of such endangered species and threatened species. Section 7 states that each federal agency shall, in consultation with and with the assistance of the Secretary of Interior/Commerce, insure that any action authorized, if any, or carried out does not jeopardize the continued existence, destruction or adverse modification of habitat...determined by the Secretary (Interior/Commerce)... to be critical unless an exception has been granted by the Endangered Species Committee.

The Endangered Species Act can completely prevent development if a proposed site is found to contain critical habitat or a population of animals or plants that are on the official endangered species lists.

The National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.) declares the national policy to encourage a productive and enjoyable harmony between man and his environment. Section 102 of that Act direct that "to the fullest extent possible: (1) The policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this Act, and (2) All agencies of the Federal Government shall ... insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations..." Detailed environmental impact statements are required if a proposed major federal action would significantly affect the quality of the human environment. The granting of permits can be considered a major federal action, depending on the magnitude and/or location of the development activity. Thus, resolving whether or not NEPA applies to a particular permit application is itself a major regulatory decision which can be the source of controversy and delay.

The Resource Conservation and Recovery Act (RCRA) of 1976 (PL 94-580; 42 U.S.C. 6901 et seq.) applies to nearly all non-agricultural, solid, and liquid wastes which are not subject to Section 402 permits. A major aspect of the Act is its two-stage regulatory program for hazardous wastes. Under Subtitle C of the Act, EPA must first establish criteria for determining the characteristics of hazardous wastes and then establish regulations, as may be necessary to protect human health and the environment, applicable to hazardous waste generators, transporters, and owners and operators of treatment, storage, and disposal facilities. Section 6004 of RCRA requires that federal agencies that generate solid wastes or that permit waste disposal must insure compliance with the Act. Although unresolved at this point, it is conceivable that land disposal of dredged material would be subject to RCRA. Should this material be classified as "hazardous waste", it would further be subject to the comprehensive Subtitle C regulatory program. In such cases development may be impeded or prevented if the dredging and disposal of hazardous waste materials is required.

The National Historic Preservation Act of 1966 (80 Stat. 915, 16 USC 470) created the Advisory Council on Historic Preservation to advise the President and Congress on matters involving historic preservation. In performing its function the Council is authorized to review and comment upon activities licensed by the Federal Government which will have an effect upon properties listed in the National Register of Historic Places, or eligible for listing. The concern of Congress for the preservation of significant historical sites is also expressed in the Preservation of Historical and Archaeological Data Act of 1974 (16 USC 469 et seq.), which amends the Act of June 27, 1960. By this Act, whenever a Federal construction project or Federally licensed project, activity or program alters any terrain such that significant historical or archaeological data is threatened, the Secretary of the Interior may take action necessary to recover and preserve the data prior to the commencement of the project. (33 CRF Part 305).

The Act requires that agencies consider potential impacts on significant historical or archaeological sites every few hundred yards which were villages of Indian tribes who have roamed the area for the past 15,000 years. This in turn influences the choice of sites for dredged material disposal.

Executive Order 11990 signed by President Carter on May 24, 1977 established a new federal policy towards wetlands. Wetlands are areas that are inundated or saturated by surface or ground water of a frequency and duration sufficient to support, and that under normal circumstances to support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.

This order directs Federal agencies to provide leadership in minimizing the destruction, loss or degradation of wetlands. Section 2 of this order states that, in furtherance of the National Environmental Policy Act of 1969, agencies shall avoid undertaking or assisting in new construction located in wetlands unless there is no practical alternative. Each agency will provide opportunity for early public review of plans and proposals for construction in wetlands, including those whose impact is not significant to require EIS preparaiton. Section 9 exempts assistance provided for emergency work, essential to protect lives, health, and property performed pursuant to Sections 305 and 306 of the Disaster Relief Act of 1974.

The unnecessary alteration or destruction of important wetlands is discouraged as contrary to the public interest. Wetlands considered to perform functions important to the public interest include:

(a) Wetlands which serve important natural biological functions, including food chain production, general habitat, and nesting, spawning, rearing, and resting sites for aquatic or land species;

(b) Wetlands set aside for study of the aquatic environment or as sanctuaries or refuges;

(c) Wetlands the destruction or alteration of which would affect detrimentally natural drainage characteristics, sedimentation patterns, salinity distribution, flushing characteristics, current patterns, or other environmental characteristics;

(d) Wetlands which are significant in shielding other areas from wave action, erosion, or storm damage. Such wetlands are often associated with barrier beaches, islands, reefs and bars;

(e) Wetlands which serve as valuable storage areas for storm and flood waters;

(f) Wetlands which are prime natural recharge areas. Prime recharge areas are locations where surface and ground water are directly interconnected; and

(g) Wetlands which through natural water filtration processes serve to purify water.

No permits are granted to work in wetlands identified as important unless the District Engineer concludes, on the basis of a public interest review that the benefits of the proposed alteration outweigh the damage to the wetlands resource and the proposed alteration is necessary to realize those benefits.

Executive Order 11988 signed by President Carter on May 24, 1977 directs Federal agencies to consider floodplain management concerns in the conduct of their ordinary business. This order outlines the responsibilities of Federal agencies in the role of flood plain management. Each agency shall evaluate the potential effects of actions on floodplains, and should not undertake actions which directly or indirectly induce growth in the floodplain, unless there is no practical alternative. Agency regulations and operating procedures for licenses and permits should include provisions for the evaluation and consideration of flood hazards. Agencies are required to prepare their procedures in consultation with the Water Resources Council, the Federal Insurance Administration, and the Council on Environmental Quality. Construction of structures and facilities on floodplains must incorporate flood proofing and other accepted flood protection measures. Agencies shall attach appropriate use restrictions to property proposed for lease, easement, right-of-way, or disposal to non-Federal public or private parties. This order revokes E.O. 11296, 10 August 1966.

Executive Order 11988, requires Federal agencies to conduct its programs in a manner which would reduce the risk of flood loss; minimize the impact of floods on human safety, health and welfare; and the restore and preserve the natural and beneficial values served by floodplains. Permits for development in the floodplain are not issued unless such development is in the public interest.

Title XIII of Public Law 90-448, signed into law on August 1, 1968 authorized a flood insurance program and provided means for necessary coordination between agencies and States as required for studies pertaining to land management, zoning or other appropriate arrangements to carry out such authority (82 Stat. 572, 42 U.S.C. 4001).

Public Law 93-234 was signed into law on December 31, 1973. This law (the Flood Disaster Protection Act of 1973) increases limits of coverage authorized under the national flood insurance program; provides for accelerated identification of flood risk zones; requires States or local communities, as a condition of future Federal financial assistance, to participate in the flood insurance program; requires the purchase of flood insurance by property owners who are being Federally assisted in the acquisition/improvement of land in flood hazard area; extends the flood insurance program to cover losses from the erosion and undermining of shorelines by waves or currents (87 Stat. 975).

The U.S. Coast Guard has wide ranging responsibilities for port safety involving requirements for siting of new facilities. Coast Guard responsibility for facility siting is one of indirect control by way of operational safety regulations and enforcement. Approval of specific geographic locations for facilities is a matter for state and local authorities. Coast Guard responsibility involves advising all parties of operational constraints and safety criteria to be applied should the proposed site be approved and determining whether and under what operating restraints vessels will be permitted access to a proposed site. These Coast Guard powers are derived from the Port and Tanker Safety Act, the Federal Water Pollution Control Act and the Magnuson Act, among others. The regulations under these Acts are contained in Title 33 CFR, Chapter I.

The Port and Tanker Safety Act of 1978 specifically provides the Coast Guard with authority to prescribe standards and regulations to promote safety of vessels and structures in or adjacent to the navigable waters of the United States and to protect such waters and their resources from environmental harm due to damage or loss of vessels and structures.

The most important sections of Title 33 CFR Chapter I for purposes of this study are:

- Subpart 6.12 - Supervision and Control of Explosives or Other Dangerous Cargo.
- Part 126 - Handling of Explosives or Other Dangerous Cargoes Within or Contiguous to Waterfront Facilities.
- Part 154 - Oil Pollution Prevention Regulations for Marine Oil Transfer Facilities.
- Part 156 - Oil Pollution Prevention Regulations For oil Transfer Operations Involving Vessels.

Part 126, in particular, gives the Coast Guard authority to grant permits for handling, loading, discharging, or transporting various categories of dangerous cargo at any designated waterfront facility.

STATE LAWS AND REGULATIONS

State authority with respect to dredge and fill operations has been expanded as a result of the Clean Water Act of 1977 (PL 95-217;33 U.S.C. 1251 et seq). Under this Act, states may administer their own permit programs for the discharge of dredge or fill material into nontidal navigable waters. After EPA approval of a state program, the Corps of Engineers to transfer its permit activities to the responsible state agency.

Other enforcement and permit activities have been passed on to the states - notably the NPDES program. Additionally, there are state and local regulations pertaining to wetlands, water quality, solid waste disposal, land use planning and zoning.

Under the Regulation of Rivers, Lakes and Streams Act (Illinois Revised Statutes, Chapter 19 § 52 et al), the Illinois Department of Transportation (IDOT) has jurisdiction and supervision over all of the rivers and lakes of the State of Illinois. An important part of this authority is the power of IDOT to issue permits authorizing the construction of structures in State of Illinois waters. Under the Act (§65), it is unlawful to make any fill or deposit of rock, earth, sand, or other material, or any refuse matter of any kind of description or build or commerce the building of any wharf, pier, dolphin, boom, weir, breakwater, bulkhead, jetty, causeway, harbor, or mooring facilities for water craft, or build or commence the building of any other structure, or do any work of any kind whatsoever in any of the public bodies of water within the State of Illinois, without first submitting the plans, profiles, and specifications, therefor, and such other data and information as may be required, to the Department of Transportation of the State and receiving a permit therefor signed by the Secretary of the Department and authenticated by the seal thereof. However, this requirement does not apply to duck blinds which comply with regulations of the Department of Conservation.

IDOT also has power to define floodplains within the State of Illinois on a township by township basis and may issue permits for any construction within such floodplains (§65f). Moreover, IDOT is charged with the duty to oversee construction or activities which might limit or impair the carrying capacity of streams in Illinois (§70).

The Illinois Department of Transportation, Division of Water Resources formerly held authority to grant permits for fleeting. Recently, this authority was rescinded. However, according to an Illinois DOT official this does not remove the requirement to obtain state approval for fleeting.

The individual port districts within Illinois have permitting authority provided by the individual port district Acts. These Acts are listed below:

- Tri City Regional Port District Act of 1959, (Chapter 19, Section 284 et al)

- Southwest Regional Port District Act of 1961, (Chapter 19, Section 451 et al)

- Kaskaskia Regional Port District Act of 1965, (Chapter 19, Section 501 et al)
- Jackson - Union Counties Regional Port District Act of 1976, (Chapter 19, Section 851 et al)

Within the State of Missouri, two port authorities require permits. These are the Jefferson County Port Authority and the City of St. Louis Port Authority.

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